BACKGROUND PERSPECTIVES

TO INTERCITY PUBLIC TRANSPORTATION

IN ONTARIO

Volume 1: Policies and Legislation

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POLICIES AND LEGISLATION

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1.0 INTRODUCTION

1.1 Scope

This report describes those intercity passenger transportation policies which in Ontario:

(a) have been legislated;

(b) form part of the planning process of the Ministry of Transportation and Communications;

(c) have been identified through statement and correspondence authorized by the Minister.

1.2 Objectives

The primary objective of this report is to indicate the direction and tone already established in Provincial policy, and the powers which the Province has obtained as being necessary to implement these policies.

Other objectives include describing areas of interaction with the federal government, and identifying possible opportunities, limitations, and priorities for the future.

2.0 BACKGROUND

2.1 Historical

The historical perspective of intercity transportation may be considered in three phases. It is useful to recall these scenarios because the tone of government involvement is inevitably a reflection of them. They may be summarized as follows:

(a) The long lasting initial phase was characterized by modal choice limited to available natural resource; one's own feet, an animal, or a water route. The government relationship was essentially one of laissez-faire except where significant national strategic consideration usually of a military nature, required direct participation in road and bridge building, canal construction, and mail distribution.

(b) The second phase, the railway era, really started the growth of intercity travel due to the coupling of the railway with initial industrial economic take-off. Government involvement was directed towards assuring an orderly development of railway services with an overall concern for financial, operational, and service stability. The powers of the state were usually derived from the national level with some input from lower levels of government. The precedent was set for substantial government support and the recognition of the peculiar economic and functional needs of transportation in terms of incentives, land use, and competition.

(c) The third phase was characterized by great economic growth with intermodal competition becoming commonplace as the technology for the internal combustion engine developed. This technology added buses, automobiles and later airplanes to the choices for intercity travel. Following the railway experience and the needs of the new transport operators, government became involved with the regulation of each of these new modes but with a more laissez-faire posture towards competition between them. Due to the local and regional nature of most highway transport movements jurisdictional control of all highway modes was delegated by the federal government to the provinces. Jurisdictional control over air travel, primarily due to its initial interprovincial role fell to the federal government with some provincial and local advisory input. A more formal breakdown of jurisdictional responsibilities for all modes is given in the Appendices.

2.2 Current

The current situation is characterized by a new interaction of stabilizing and destabilizing forces. The modes have become technologically and competitively stabilized but the economic and social trends which produced this now appear to be changing directions. As a result, different levels of government are now financially supporting modes, and parts thereof, on a selective basis. There are changed areas of profitability within modal operations, although in some instances there is little real competition. Furthermore, transportation is being affected by changing perceptions of lifestyle and the use of resources. The economic and competitive environment for passenger transportation has become so clouded and subjected to distortions that there is hardly a marketplace measure available with which to evaluate conditions, or to ensure that public convenience and necessity are being met on either micro or macro scales.

In the previous decades of intercity transportation, the challenge to one mode came from another mode which had characteristics making it more attractive to a particular segment of the market. When rail dominated the intercity journey was primarily by mainline rail but also electric interurban. Subsequently, short-distance travel by either of these modes was subjected to increasing competition from buses, due to their greater routing flexibility and lower capital costs. In turn, both rail and bus travel succumbed to the private automobile, due to its almost infinitely variable route, schedule flexibility, and competitive marginal costs.

For medium-distance intercity travel, the automobile now dominates, although there are still significant origin-destination examples where multimodal competitiveness still exists to the extent that the automobile share drops to the 40-80% range. In some situations, such as the North, the mode most relied upon is often dictated by topography, climate, and other constraints.

Intercity passenger transportation had reached a reasonably stable position by the beginning of the last decade primarily due to carrier and user interaction rather than from the early-stage government support. The equilbrium reflected a stabilization of demand and supply which for 30 years had been working within a buoyant economy and an expansionist lifestyle. The economic and social environments have now so changed that if intercity transportation were allowed to proceed in an non-regulated, unsupported manner the evidence suggests that the result would be the demise of all intercity rail passenger service, the reduction of bus services below present levels, possibly a lesser growth of air service, and an even greater automobile dominance.

2.3 Outlook

Several differences in both industrial and environmental conditions have occurred from those under which the modes developed competitively.

The first difference is a stabilization of technology without the foreseeable introduction of any new mode or radical functional changes to existing ones. For rail, the costs and engineering works associated with attainable levels of speed and comfort have been clarified. The only known frontiers remaining are such concepts as Maglev and GVT (gravity vacuum tube), intended for corridor high-speed applications at some still uncertain time in the future. Bus performance is essentially determined by the highways used and the traffic sharing them, although some improvements in comfort, and perhaps size, can be expected. The size of aircraft, their propulsion technology, and operating speed appear to have reached a plateau. The automobile has not yet reached a universal stabilization of design to maximize its potential usefulness but it perhaps close enough for long-range planning purposes. This means that intercity travel will be functionally performed in the coming 20 year span by technology which already exists, or is close to existing.

The second difference is that the financial, manpower, and other resources, which were once put into transportation development by the private sector alone, have now declined and are only forthcoming when government is also willing to invest. This is the case for the design of new aircraft, buses, and trains; for the implementation of most new services, and is selectively occurring in the auto industry. The place to which private capital can still be attracted, and which affects the transportation industry, is the area of energy resources, although even there, government is involved for a variety of reasons.

A third difference in the foreseeable future, when compared to the past, lies in the general economic stability of our society. Events have shown themselves capable of unexpected and sudden changes. A continuing decline in the real growth rate of the Western nations seems a likely scenario which will be worsened by deficiencies and tensions both with and in the rest of the world. These conditions have already been reached in Ontario where all modes are currently affected by an economy which exhibits uncertain buoyancy, produces increasing pressures for government support intervention, and is experiencing lifestyle changes.

The fourth difference is due to a culmination of the three already identified. This difference is that the nature and timing of potential impacts on intercity transportation, such as national fuel supplies, economic decline, or the lack of a new developing mode, are beyond the responsive capabilities of

the intercity transportation industries. The objectives and mandates of transport operators do not necessarily coincide with the larger resource and economic issues. Except perhaps for the oil companies, the institutional leverage of the transport industries upon the larger issues is becoming minimal. As well the time frame for their conventional marketplace response may be much longer than the timespan which could be available from an external economic or resource jolt. These circumstances have already lead to a more cautious approach by private and crown-owned profit-motivated transport companies, as they need to be sure that they are investing in the best alternatives available.

There may be inadequacies in intercity transportation from the viewpoints of both the industry and the consumer. Adjustment of these inadequacies is no longer necessarily possible without government policy involvement of some sort, even perhaps requiring the formulation of an overall long-range strategy with tactical components.

3.0 GENERAL POLICY STRATEGIES

3.1 Intentions

The Ontario government is concerned with all transportation modes, services, and facilities which significantly impact upon the social and economic well-being of the people of the Province. Part of this posture is to ensure that safe and adequate public transportation services are provided to all parts of the Province, including northern communities with their unique characteristics.

3.2 General Directions

Generally, there has been a shift in policy emphasis from one which was basically auto-oriented to one which addresses a multimodal transportation system. This is being reflected in the transportation expenditures within the Ministry budget. Changing priorities of the government, as well as the state of the economy, have impact on these shifts. Within the Provincial Roads Program, for example, a much greater emphasis is being given to highway maintenance than to capital construction due to financial restraints, and a maturing highway network. In general, greater emphasis is to be placed on making optimal use of existing facilities and services as an alternative to capital investments. The financial situation is made more difficult by the federal government recently taking a less involved role in local and regional matters than traditionally has been their responsibility. The concern of Ontario is that increased provincial involvement may be required in order to ensure that provincial residents receive adequate service.

3.3 Provincial Intervention to Implement Policies

The Province has followed one underlying philosophy to warrant intervention and the precedent goes back to the turn of the century with application being made to all modes. Essentially, the Province will only intervene directly if it is assessed and judged through the accepted political process that the "marketplace," as it exists at the particular time and to the planning horizon, will not produce the facilities and/or operations which are assessed and judged as desirable in terms of one of the following:

(a) Providing access to communities and to support or enhance their economic activity; (these deficiencies can be met by investment in facilities and operations);

(b) Ensuring the use of appropriate modes in a targeted cost-effective and service-effective manner; (this is attempted through licensing and regulation).

In virtually all cases, it is not possible to quantify or even have standard yardstick definitions of the terms and warrants in the two sub-paragraphs above. Even the "marketplace" is a product of past government and private interactions and is not representative of perfect or free competition. Thus reliance upon subjective assessments is partly due to the functions which transportation is intended to serve, and partly due to the complex nature of transportation itself. This thrusts a particular burden upon the political process.

3.4 Policy Administration Techniques

(a) Direct funding and/or technical assistance from the Ministry to local agencies (e.g. airport improvement)

(b) Establishing crown public bodies to
  (i) own or lease transportation facilities and equipment (e.g. ONTC), or
  (ii) operate services, or sub-contract operation to private or public companies (e.g. TATOA)

(c) Establishing regulatory agencies (e.g. OHTB)

(d) Issuing Ministerial policy directives as guidance to any of the above (e.g. to OHTB);

(e) Providing for some public input through the establishment of agency governing bodies (e.g. TATOA) and/or the process of hearing (e.g. OHTB);

(f) Influencing other governments.

3.5 Summary of Facilities and Operations Provided

The Province has provided facilities and operations in geographical areas of the Province with either very low concentrations of population and/or difficult access (the north and southeast), or areas with unusually high concentrations of population (the south-centre). This has produced a variety of government activities which include: owning and operating railways, rolling stock, buses, aircraft, and ships; building and improving airstrips and equipment; and contracting with public and private agencies, or creating public agencies to carry out these and other tasks.

In the case of the northern rail services, the Province undertook, at the beginning of the century, to build rail facilities to exploit development of resources north of North Bay and to connect to privately-financed lines already being built. Within the same area, essentially due north of the North Bay-Sudbury line, the ONTC also operates a bus service which sometimes competes with rail service. Interconnections and joint arrangements are also made with other public bus and rail carriers outside of this area.

For certain remote northern communities, the emphasis is upon ensuring year-round access, and to this end, there are the Remote Airport Programs (MTC and MNA), and the Navigational Aids Program (MTC). In the past, navigational aids have been recognized as a federal responsibility, and this latter provincial program was only produced as a necessity to fill a void until the federal government resumes its traditional role. There are many privately sponsored and owned aids, so that the public program is limited in scope.

In addition to the northern air services provided by public and private carriers, there are privately operated but publicly equipped and subsidized, services which are administered through ONTC under the norOntair scheme. The purpose is to assist in economic development and access, but the emphasis appears to be upon the former as most traffic is of a business nature. Of the 20 communities served, 13 have bus and rail service, 6 have bus, and only 1 has no other mode of public transportation. Thus, norOntair sets an example of how the Province intervenes in areas already served by private bus and public rail carriers, in order to provide a significant step towards creating a network which, at least, extends the range of market differentiation and service efficiency.

Turning to the southern part of the Province, the metropolitan area of Toronto provided the catalyst for instituting Provincial financial and planning intervention in urban public transportation. This first occurred through capital financial support for subway construction and then in other transit purposes. The policy to intervene in enlarged urban operations was initially promulgated through the Commuter Services Act which established appropriate powers that may appear to be virtually unlimited in scope. The use of these powers by a particular Authority, which would be responsible for a defined metropolitan area, was carried out through the Toronto Area Transit Operating Authority Act. The establishment of TATOA indicated the commitment of the Province to a multisystem bus/rail network of urban regional transportation, and implicitly acknowledged that such an approach is unlikely to be developed by the individual systems without an overall empowered body with network-wide horizons.

The geographical area and nature of this intervention expanded until there are now examples of provincially planned and subsidized GO Transit bus and rail routes running from Guelph to Oshawa, a distance of 125 km. GO Transit vehicles are also periodically lent, on a rental basis, to assist other carriers on busy travel weekends.

4.0 MTC ADMINISTRATIVE/PLANNING POLICIES

In March 1984 the Strategic Policy Committee issued a revised Strategic Directions booklet. Directions and objectives that are especially pertinent to intercity passenger services include:

(a) "To ensure that a reasonable choice of transportation services exists for the mobility of all people...within Ontario and between Ontario and other jurisdictions.

(b) To preserve public and private transportation systems essential to Ontario, now and for the future.

(c) To promote effectiveness, efficiency, environmental acceptability, safety and energy conservation in all modes of transportation operating in the Province.

(d) To continue to encourage intermodal connections linking VIA Rail and the bus companies and continue to study intercity bus and automobile transportation."

Regarding intercity passenger transportation, the major differences between the 1984 Strategic Directions and previous policy guidelines are the elimination of citing certain areas (e.g. the north, the six major urban centres) for special programs and the broadening of the remaining guidelines.

4.1 MTC Planning Guidelines 1981-1983

Ministry guidelines especially pertinent to intercity passenger services have included:

> "To ensure that essential movement of people...can be made with greatest effectiveness in relation to capital investment, operating costs, energy consumption, and environmental impact.
>
> Develop a comprehensive policy framework, within which provincial position can be articulated, aimed at employing a multimodal approach to providing interurban and interregional services for the transportation of goods and people in Ontario without being restricted by the limitations imposed by existing jurisdictions.
>
> Employ and promote use of the most effective mode of transportation service or mix of modes to satisfy the needs of the six major urban areas, smaller centres, rural communities and remote communities."
>
> "Ensure satisfaction of the established economic and social needs of isolated areas through the provision of appropriate and cost-effective transportation systems between them and the urban areas to which they relate."

The Program Objectives which have been identified in Guidelines are:

> "Develop an integrated policy framework concerning public transportation systems whether under provincial, federal, or private sector control which will address the requirements of all areas of the Province for the interurban movement of people and goods."
>
> "Represent the public interest of Ontario with respect to transportation systems operated or controlled by the Government of Ontario (ONTC, TATOA),the federal government, and the private sector."
>
> "Remove the isolation of and improve access to identified northern settlements and designated municipalities, to encourage economic development and provide access to all public services."

It will be noted that reference is made in the above to "...six major urban areas...". The reason for this was outlined in the Guidelines:

> "Demographic trends and settlement patterns indicate that population and industrial shifts towards urban centres will continue. There will be increasing concentration in the major urban areas in and around Toronto, Hamilton, Kitchener-Waterloo, Ottawa, London, and Windsor. Most of the two million population increase between 1980 and the year 2000 will occur before 1990 and will be concentrated in these six areas. It is further anticipated that the movement of population and industry from city cores to suburbia will continue, presenting new problems in providing for the efficient movement of people, goods, and information."
>
> "The Ministry's concern must be directed towards the resolution of the increasing transportation and communications problems of these urban areas and of the links between them, particularly with the prospect that decreasing supply and increasing price of energy will adversely affect the mobility of residents."
>
> "Concentration of population and industry in these six areas can threaten the continued viability of smaller urban centres and has the potential for increasing the isolation of rural, remote and northern communities. The Ministry, being responsible for transportation and communications throughout the whole of the Province, must deal with these trends by ensuring the maintenance of the facilities and services necessary to assist continued and improved integration of the smaller urban centres and communities into the economic and social life of Ontario."

The Guidelines, and comments by the Deputy Minister, are also a source of reference to specific modal issues:

> "Ensure that the provincial highway system continues to provide a service meeting the economic and social needs of the Province."
>
> "...the Province encouraging improved rail technologies, for both passenger and freight services, appropriate capacities at key transfer points, and the modernization of signalling and roadbed."
>
> "...the continued development of regional air services in Ontario, with more use of fuel-efficient, Ontario-designed STOL aircraft and a larger provincial economic development objectives."
>
> "Prepare and implement comprehensive policy on intercity busing and bus services to smaller centres."

The Guidelines also contained reference to the strategies to be followed in meeting objectives:

> "Develop comprehensive policy in parallel with work on immediate issues, problems, and interventions in the following areas: rail, air,... commuter services, intercity bus,... transportation industry strategy."
>
> "Take a lead role in overcoming institutional barriers..."
>
> "Determine quality and quantity disparities in transportation...services and the requirements of the residents of each region of the Province."
>
> "Invest in market research techniques for policy analysis and planning, and share market research findings with interested agencies, such as the bus industry, the Ontario Highway Transport Board, etc."

5.0 FEDERAL/PROVINCIAL INTERACTIONS

According to the British North American Act the responsibility for regulating intercity public passenger service belongs to the federal government. In 1954 the federal government delegated much of its regulatory powers over the bus industry to the provincial governments although some powers were retained. Appendices A and B outline the various jurisdictional powers that the federal and provincial governments respectively have with regards to all modes of intercity transportation.

Most of Ontario's current intercity public transportation network and the policies governing it were formulated in response to the 1960 Federal Royal Commission on Transportation (MacPherson Commission) and the subsequent National Transport Act of 1967. This Commission primarily focused on railway related issues but also stated the broad intentions which Federal and Provincial governments should follow regarding bus and airline traffic as well as intramodal and intermodal competition. It is important to note the crucial references to modal competition cited below. The National Transportation Act is reviewed in more detail in Appendix A. The rest of this chapter comments on four areas of federal/provincial interactions; intermodality, railways, buses and air services.

5.1 Intermodal Policies

The National Transportation Act Section 3 gives the basic philosophy of the Federal Government in transportation matters.

> "It is hereby declared, an economic, efficient and adequate transportation system making the best use of all available modes of transportation at the lowest total cost is essential to protect the interest of the users of transportation and to maintain the economic well-being and growth of Canada; and, that these objectives are most likely to be achieved when all modes of transport are able to compete under conditions ensuring that having due regard to national policy and to legal constitutional requirements,
>
> (a) regulation of all modes of transport will not be of such a nature as to restrict the ability of any mode of transport to compete freely with any other modes of transport;
>
> (b) each mode of transport, so far as practicable, bears a fair proportion of the real costs of the resources, facilities, and services provided that mode of transport at public expense;

(c) each mode of transport, so far as practicable, receives compensation for the resources, facilities, and services that it is required to provide as an imposed public duty; and

(d) each mode of transport, as far as practicable, carries traffic to or from any point in Canada under tolls and conditions that do not constitute an unfair disadvantage in respect to any such traffic beyond that disadvantage inherent in the location or volume of the traffic, the scale of operation connected therewith, or the type of traffic or service involved."

As part of the 1972 Ontario submission to the House of Commons Standing Committee on Transport and Communications, in connection with rail service discontinuance, the Province very clearly indicated its interest in a multimodal approach under the National Transportation Act:

> "It has been, and is now, the position of the Government of Ontario that no passenger train service should be discontinued unless and until a comprehensive coordinated analysis of the interrelationships between the various modes of passenger transport in Canada has been carried out. This embraces the concept of a total passenger transportation market that must be rationally allocated among the various modes of passenger transport. The Government of Ontario believes that the passenger transport system in Ontario and in Canada cannot be developed on an ad hoc basis. It is our position that the future requirements for passenger transportation demand a coordinated approach to the supply of these facilities. We believe that until the requirements for a minimum passenger network have been determined, it is illogical to hear any applications for discontinuance."
>
> "We further believe that such an inquiry must be related to a coordinated study of the interrelationships of various other modes of available passenger transport. Only in this way can the aim of the National Transportation Act, that is, to achieve the most economic, efficient and adequate transportation at the lowest total cost," be attained. What is required then is a plan embracing all modes of transport, a yardstick against which any application for discontinuance could be measured. Surely, in this stage of our development, it is unacceptable for a regulatory tribunal to deal with an application for discontinuance of one mode of transportation without a thorough understanding of the effect of such a discontinuance on the region involved."

In 1975, the Ontario Minister of Transportation and Communications responded to proposed changes to the federal National Transportation Act with a statement in the Ontario Legislature which took provincial views on multimodal coordination a step further:

> "Ontario also recognizes that solutions to transportation problems must be coordinated to make the best use of available modes irrespective of formal jurisdiction. It is especially important under current economic conditions that there be a rationalization of the use of the taxpayers' dollar between governments to prevent wasteful expenditures for cross purposes."

In January of 1976, the federal government announced a program to Rationalize Rail Passenger Services in Canada. The provincial response to the Canadian Transportation Commission (CTC) again included reference to the need for a multimodal approach which could meet objectives at minimum cost and maximum stability:

> "We are currently reviewing this situation and will continue to press the federal government for adequate rail service. If rail service is to be curtailed anywhere, it must be replaced by an adequate combination of rail, bus and/or other services."

5.2 Rail Policies

Intercity rail passenger transportation now generally involves railroad companies which provide trackage, switching, scheduling services, etc., and VIA Rail Canada, Inc. which provides the passenger-related rolling stock. The intercity movements, with the exception of a few remote rail captive communities are directly competitive with provincially regulated bus companies.

At the present time, the most pressing provincial concerns are over federal intercity passenger services being carried out by Via Rail. These include the following aspects:

(a) The need for prudent financing of deficits, due to the large Ontario participation in such support;

(b) The need to examine alternative strategies and modes; the effect of VIA fare and service policies upon competing carriers;

(c) The need for service integration with modes under provincial jurisdiction;

(d) The Via proposals for a new high-speed rail routes in the Windsor-Quebec corridor;

(e) The recognition of federal administrative and fiscal responsibilities in these areas and their resulting effects.

These interactions have been taking place between the two levels of government at ministerial and staff levels and the nature of these communications have varied from meetings between the two parties; to the establishment of joint committees; to formal interventions by the Province at CTC hearings. Although the latter procedure may be in response to specific changes, such as service discontinuances, the submissions of the Province tend to be concerned with establishing principles which ensure that local and provincial needs and desires will be at least considered.

The importance of government interaction, and the willingness of Ontario to participate, was clearly stated in 1972, in a submission to the House of Commons Standing Committee on Transportation and Communications:

> "It is the position of the Government of Ontario that investigations and studies of the sort that I have referred to must be carried out jointly by the two levels of government. As a provincial government, we find ourselves placed in the position of having to react to the decision of federal regulatory agencies and being expected to fill the vacuums caused by their decisions. Such a process is both illogical and wasteful. Many of the resulting problems could be avoided by studies of the nature that we have suggested and by prior consultation between the two levels of government."

In 1975, the federal government concluded that the policies and activities under the National Transportation Act were not achieving desired transportation objectives. In order to improve the situation, a new National Transportation Policy was developed which included proposals for extensive rail rationalization under such guidelines and comments as:

> "Where passenger trains are poorly suited to the market, or poorly positioned, the Government intends to encourage other modes to replace them."
>
> "Rail service would also be continued in remote areas where no other transportation alternatives exist."
>
> "The directives to the Canadian Transport Commission are aimed at a total rail passenger plan to be developed in progressive stages by 1978. These are as follows:
>
> (a) early action on local or regional cases where no major public need for continuation of service is obvious;
>
> (b) transcontinental service between western and central Canada by late 1976;
>
> (c) service between the Maritimes and central Canada by 1977;
>
> (d) the remainder, including regional and intercity services not dealt with previously, by 1978.

The following four categories indicates the areas where Ontario has formulated, adopted and announced provincial policies, each of which will be discussed below:

(a) Transcontinental Rail Rationalization

(b) Rail Service Discontinuance

(c) Service to Remote Areas

(d) The Windsor-Quebec Corridor.

The objectives of rationalization of the CN and CP transcontinental rail services has been a major part of the federal perception of putting rail transportation into a competitive position in accordance with the principles set out in The National Transportation Act. Because of the rerouting of the transcontinental lines through Northern Ontario, this issue is inextricably involved with provincial concerns related to servicing remote northern communities, the Ontario Northland Railway, and transportation in the Northeast corridor generally.

The Province's position in respect of this matter was made known to the Legislature in a statement by the Minister of Transportation and Communications in 1976. The following extracts, which particularly relate to transcontinental rail are reproduced below:

> "At the same time I shall advise the Minister of the importance Ontario places on rail passenger service as well as the position my officials will be taking at the Canadian Transport Commission's hearings in Ottawa commencing at the end of the month. The latter, of course, focuses on the rationalization of the CN-CP transcontinental rail passenger services."
>
> "In the matter of the CTC's economic rationalization hearing on the CN and CP transcontinental passenger rail services, I shall inform Mr. Lang that Ontario supports in theory the principle of such rationalization. This is on the assumption, however, that rationalization does not involve the transfer of financial responsibility of replacement services to the Province of Ontario."
>
> "Nor will our support imply acceptance should there be discontinuance of portions of the transcontinental which currently provide an essential service to our northern communities."
>
> "I shall insist that should the CTC rule in favour of discontinuance in such areas, these services must be replaced by local rail or acceptable alternate services tailored to fit the affected communities' needs."

In 1977 the Federal Government issued its "Preferred Plan for Western Transcontinental Passenger Train Services". The Ministry of Transportation and Communications prepared a position paper on the subject which, by direction of Cabinet, was submitted to the Canadian Transport Commission. The main points in the Provincial position are summarized below:

> "The Province of Ontario must stand opposed to "The Preferred Plan for Western Transcontinental Passenger Train Service" as issued on May 2, 1977 unless the concerns stated below are satisfactorily addressed in the Final Plan expected in the fall 1977."
>
> "The Final Plan must make specific provision for consultation with this Province to ensure that negative impacts on Ontario's residents are minimized and that positive benefits of rationalization are maximized."

Certain specific concerns were expressed over the Toronto/ Sudbury/Northeastern Corridor:

> "Ontario recommends that the Final Plan, recognize the need for the integration of the Transcontinental Service, through appropriate schedules, with a feeder service to the Cochrane-Timmins-Kapuskasing areas, complemented by appropriate regional services in this corridor, which includes Toronto-North Bay."
>
> "Ontario also recommends that a specific directive be given to VIA to coordinate, and by ticketing, schedules, etc., to facilitate integration of transcontinental rail services with these regional and feeder services."
>
> "Ontario recommends that specific criteria and guidelines be given in the Final Plan to ensure a full assessment of the benefits and disbenefits of the Sudbury-Toronto trial service as a prerequisite for any consideration to discontinue or replace the services."

The needs of the communities in the north were also addressed by the following comments:

> "We recommend that the Final Plan provide for a redesigned service which would more adequately accommodate the local and through travel needs of Northern Ontario. This would require convenient access and schedules, and turnarounds at selected intermediate Towns in Northern Ontario. Such a redesigned service must also recognize this Province's legitimate social and economic interests in this region of Ontario."

There was apprehension that the pricing policies of VIA could adversely effect the financial health of the intercity bus industry:

> "Ontario recommends that the Final Plan contain a directive that precludes the setting of rail fares at levels which would in any way jeopardize the viability of intercity bus operations in this Province."

Of great importance to the Province was the potential for attempts by the Federal Government to use rationalization to shift financial responsibility:

> "We submit that the Final Plan must guarantee that there will be no transfer of financial liability from the Federal to the Provincial level of Government, and, that the savings achieved through rationalization in Ontario be allocated to offset the costs to the Province of other transportation services required."

The vital importance of planning and consultation with the Province was recognized:

> "Ontario submits that the Final Plan must give Via sufficient flexibility and a clear directive to consult directly with this Province in order to detail the implementation of the Final Plan and its objectives while fully considering Provincial Policies, Requirements and Concerns."

The "Final Plan", which was released by the Canadian Transport Commission in October 1977, largely met the concerns raised by the Province. However, the matter of VIA fares jeopardizing the viability of intercity bus operations is still an issue and was raised in correspondence between the Minister of Transportation and Communications and the Federal Minister of Transport (Hon. Donald Mazankowski) in September 1979.

Focussing on mechanics of rail service discontinuance, Ontario commented upon the process and introduced the desirability of using wider economic-benefit measurements:

> "Uneconomic passenger train service is defined by the Canadian Transport Commission as one which is incapable of being rendered profitable to the railway under any feasible alterations in railway operating practices, equipment assignment, scheduling, pricing, or other aspects of passenger service under railway control. It is the position of the Government of Ontario that such definition is unacceptable as it is too narrow and in fact excludes the very considerations which are most important in determining whether a passenger train service should be continued. That definition assumes that the entire range of benefits

produced by a passenger rail service can be captured in the profit and loss ledgers of a railway company. An example of an economic benefit that can and does accrue from the operation of an efficient passenger rail service is increased industrial and commercial investment. This economic benefit, of course, does not turn up in the railway companies' revenue accounts; it is none the less real. Industry is unlikely to locate in an area which is deficient in passenger transport facilities. The loss of such an industrial or commercial undertaking represents a cost or a loss to the community involved, which is not charged to the railway's account."

"How do you place a cost on the increased air pollution which results when a passenger train service is discontinued and the abandoned populace takes to its cars? Is it possible to place a value on the cleaner air which results when an efficient passenger rail service is reinstated and those cars stay in their garages? Such benefits are difficult or impossible to quantify but they are none the less real economic benefits that we submit must be included when determining whether a passenger rail service is 'uneconomic' or not."

At the same time, the Minister had stated in a public address:

"While travelling through the North, many people have expressed to me their very real concerns that as a result of the Canadian Transport Commission's recommendations, crucial passenger rail service across the North via the Canadian National tracks will be cut back.

We find it both shocking and impossible to accept that the Federal Government's heralded new VIA Rail plan which was supposed to improve rail service actually curtails rail service in Ontario. This is the kind of help we can do without.

We have insisted -- and will continue to insist -- that designing of a service better suited to the needs of people anywhere along the route as well as those residents on any feeder routes is the criterion that should be used. We want them to assess it in human terms rather than purely in economic terms."

In March 1976, Provincial staff became involved in a Federal Windsor-Quebec corridor study, with specific concern for the integration of rail and bus systems and rail crossing components. They also sat in consultation on the marketing, infrastructure, equipment and costing procedures sections.

In May 1976, the Federal Government announced that the Quebec-Montreal portion of the corridor would be developed first. To this announcement the Province reacted with a statement in the

Legislature by Hon. James Snow, Minister of Transportation and Communications, the most significant portion of which is reproduced below:

> "These federal initiatives were greeted with considerable enthusiasm by my Ministry -- because we, too, recognized the opportunities that existed, particularly in the Toronto-Windsor segment of the corridor. And we felt that, as a result of the proper integration of passenger transportation modes, we could create an efficient and economic passenger system serving all the western counties."
>
> "In addition, this potential re-assessment of passenger transportation would have permitted us to redress the problems created by the discontinuance of rail services in the Grey-Bruce area in 1970.
>
> Now, today, we have been told that the initial efforts will only include the Montreal-to-Quebec City corridor.
>
> Mr. Lang's statement, flying in the teeth of the fact that the Toronto-Windsor segment serves the densest populated area with the highest economic potential along the entire length of the originally proposed corridor, leaves me very disappointed."

The current situation in this matter is unchanged. During the debate on the Ministry's 1980/81 Estimates, the Minister of Transportation and Communications said:

> "I certainly do have discussions with the Minister of Transport. We have been continually pushing for the upgrading of the corridor between Quebec City and Windsor, which we feel is one rail corridor that can be improved and on which the ridership can be increased."

5.3 Air Policies

Air transportation is jurisdictionally under the federal government, with the CTC being the designated regulatory body. Thus there can be no Provincial regulatory legislation, but only legislation as might be required for the Province to arrange for or actually carry out a public service. This has in fact been done in order to provide the norOntair services.

The medium for implementing these services has been the ONTC, which owns the aircraft and administers the service and contracts with private companies for their operation and maintenance. The authority for doing this is embodied in the ONTC Act which is presented in more detail in Chapter 7.

The direct entry of the Province into providing air services occurred with the formation of norOntair. In 1971 norOntair started servicing communities in Northeastern Ontario.

In 1974 the Northwest area became operational, and a statement made by the Minister on the occasion of the award of the second operational contract sets out the intent and mechanisms:

> "... Northern Ontario ... needs transportation if it is going to realize its full potential. Because of the vastness of the country, it needs air transportation. The private" "carriers cannot afford, today, to provide air services to all the centres which could benefit, nor with the level of service and the modern equipment which would attract patronage. It is a textbook example of the need for public intervention."
>
> "The policy of the Government is to complement the contribution of the private carriers, not to compete with them; to encourage the growth of the private carriers; and to create an atmosphere where healthy and friendly competition can work to the ultimate advantage of the entire community."
>
> "In the North, Ontario Northland Transportation Commission is charged with implementing this Government policy. It's role is broader than simply administering the NorOntair operations. ONTC will serve the private carriers as advisor and coordinator; it will assist in integrating services, timetables, ticketing and marketing; it will encourage the development of better ground support facilities. ONTC is the on-the-spot arm of my Ministry."

In the same year the second-stage Northwest services were commenced, and on this occasion the Minister mentioned the several factors which appear to be the combination which makes NorOntair a successful venture:

(a) Government planning towards meeting broad-criteria transportation needs.

(b) Implementation and administration through a Crown operating agency.

(c) Operation and maintenance by the private sector.

(d) NorOntair services make schedule connections with the major carriers, and 50 to 60 percent of passengers use them.

(e) Aircraft owned by a Crown corporation.

(f) Facility improvements carried out by municipalities with Provincial financial and expertise assistance.

(g) Provincial support of licence applications to the Federal ATC (CTC).

The provision of norOntair service is only a part of Provincial strategy to enhance air transportation as a matter of policy. The establishment or improvement of airports to specifications and the installation of navigational aids are two other aspects. The philosophy of these policies was summarized by the Premier in a statement in 1977:

> "... while provision of effective air transportation for Northerners is our most important objective, it is only one of the reasons for our concentration on airports in the North. A network of good quality airports strategically located in the North is absolutely essential for emergency mercy flights, for search and rescue, for lowering the cost of essential goods in communities with no other link, for forest fire control, for geological surveys, for tourism and in general for improving access to remote areas for development and jobs. We envisage a strategic network of paved airstrips of 5,000 feet, supplied with essential ground equipment."

There are two programs pertaining to airports, one designed for the far north and one for the near north. The former, started in 1968, is the Remote Airport Construction Program which provides Ministry expertise and financial subsidy. In a decade it has resulted in an almost fourfold increase in the number of airports. The second is the Municipal Airport Program which has resulted in over a score of municipal airports being developed or improved. There are two sets of criteria these programs:

(a) Providing access to communities and areas which do not have year-round access by surface modes.

(b) Economic development.

The navigational aids program is aimed at overcoming deficiencies in directional guidance, weather reporting, and the maintenance of the required ground-to-air communications. Although some necessity exists for this program throughout the Province, the most critical need for action lies north of the 50th parallel. The emphasis of the Province has been the necessity for a public system which is accessible to and safe for all aircraft. The Province has maintained pressure upon the Federal Government to meet its obligations, but has also provided short-term funding for navigational aids to cover federal deficiencies.

The Provincial position on the regulatory procedure was indicated in a 1979 letter by the Executive Director of the Planning Division:

> "... we suggest that the regulator be equipped with regulations that will encourage carrier initiatives and inspire entrepreneurial independence. The regulatory process should not be encumbered with unwarranted or unnecessary procedures. Such procedures often result in significant administrative and legal costs -- not only for the carriers, but for the regulator as well."

> "... it is apparent to us that the existing regulatory procedure that an air carrier must follow in order to get a licence to operate domestically in Canada is often cumbersome and costly. Perhaps more significantly, from the operators point of view, is that the process can be very time consuming. It is suggested that such delays are not in the best interest of either the carrier or the air travelling public."
>
> "In particular, we are concerned with those situations where a carrier has applied to provide a service over a route, or between two city pairs, where no other air carrier currently operates. Under such circumstances, the simplification of existing regulatory requirements would appear to be in order. More specifically, we would suggest that less emphasis be placed on the carrier to prove that the proposed service will be required by the present and future public convenience and necessity. In this manner, entry control could be made easier, less costly, and slanted more to the requirements of overall demand and carrier initiatives."
>
> "... in dealing with mergers and acquisitions between smaller carriers, it is suggested that the process could be streamlined. This is particularly true where no reduction in the quality or level of service previously provided will result, and/or in those situations where no objection to the proposed transaction has been registered."
>
> "Perhaps it would be appropriate to establish guidelines, based on either the party's current financial level or the class of service(s) provided, against which simplified regulations could be established. In this way, the regulatory requirements would be more in line with the type of service (and degree of public exposure) being offered. The smaller the service, the less the regulatory procedure would appear to be necessary to deal with them."
>
> "... in the context to the federal government's current role of having total responsibility for the regulation of Canadian air services, we would ask that the provinces be afforded an opportunity to provide direct input into air transportation matters. In particular, with matters concerning the establishment of intraprovincial air services, it is apparent that the province would be in a strong position to formally comment on the appropriateness of such services."

In terms of reduction in the regulation of operations and pricing, the position of the Province has been made clear in the above and other correspondence of 1980:

> "In reviewing the pertinent sections of the Air Carrier Regulations dealing with the topic of fares and tariffs, it is evident that the filing requirements placed on the

carriers are very detailed... We note that economy fares are often similar; however, more recently the carriers have begun to offer a wider range of discount fares. It is our view that the public would be better served if the carriers were to become even more active in this area of market competition. At the same time, carrier competition involving passenger service amenities should be encouraged."

"... inter-airline agreements should not be permitted, in those cases that have the effect of restricting carrier competition. This is particularly critical in high density markets, where direct competition between carriers should be encouraged."

"Generally, government intervention should only be in situations of predatory or discriminatory pricing practices, protecting the consumer against monopoly powers and protecting the airlines from prices which are artificially low because of direct and indirect government subsidies."

"One of the stimulating effects on competition and innovativeness of the airline industry would be the removal of unnecessary restrictions (e.g., on capacity, pricing) imposed on this industry by governments. The airline industry should be allowed to have more freedom in the decision-making process regarding operational matter and on price-setting for services they offer. Decisions such as the size, or frequency of service, the number of aircraft required to satisfy such demand, can be more efficiently judged by the air carriers themselves. In this manner, the operational efficiency of the air transportation sector can be greatly enhanced."

A situation with regard to the regulation of foreign carriers serving Ontario, and the regulatory postures of their home countries, was indicated in 1980, by the Deputy Minister:

"Ontario is of the view that to permit, as suggested by the United States proposal, open and virtually unregulated transborder air services may not be in the overall best interests of Canada's transportation industry. The American proposal is one that I cannot agree with."

The other aspects of air transportation which are of current interest to the province are:

(a) A regional carrier;

(b) The use of STOL.

The view on the first was put to the ATC on the occasion of the hearing for the Toronto-Halifax route in 1980:

> "... there should be three strong, viable regional carriers allowed to develop in eastern Canada: one based in Ontario, a second in Quebec, and a third in the Atlantic Provinces."

There is an anxiety on the part of the Province over the lack of clear Federal policies towards regional carriers. Although a Regional Air Carrier Policy was announced in 1966 and updated in 1969, it is considered by the Province to be deficient for present conditions and hampers consistent CTC rulings. An updating was promised in 1977, but has not yet been done.

With regard to STOL, the Province has stated, to a CTC hearing on a proposed service from Toronto Island, that its support reflects the following options:

(a) Such a service can be feasible and desirable in certain circumstances:

(b) Quiet aircraft be used;

(c) The range of alternatives available to regional travelers can be thus expanded;

(d) Peak facilities and loads at major airports can be reduced;

(e) The use of Canadian technology would bring domestic economic benefits.

6.0 PROVINCIAL BUS POLICIES

The federal Motor Vehicle Transport Act (1954), which functions under the umbrella National Transportation Act, delegates to the provinces the power to regulate both interprovincial and intraprovincial highway carriers. This Act states that:

> "The provincial transport board in each province may, at its discretion, issue a licence to a person to operate an extraprovincial undertaking into or through a province... upon similar terms and conditions as if the undertaking operated only in that province."

Similarly, the filing and control of tolls and tariffs charged for extraprovincial transport is under the jurisdiction of the province where the transport takes place, and at the discretion of that particular provincial transport board.

This Act places the authority for the control of public road transportation in the provincial jurisdiction where the transportation takes place. It should, however, be noted that this Act is closely bound with the NTA and could be modified by Part III of the NTA. More information about these Acts is available in Appendix A.

In Ontario the Public Vehicle Act (1955) governs the provision of transportation services for passengers and regulates public vehicles operating on the highways. The Act is administered by the Minister of Transportation and Communications, his Ministry, and the Ontario Highway Transport Board (OHTB). As such, its direct concern is confined to intercity bus service operators through the medium of licencing, and associated route and charter certificates. More details on the OHTB and PVA are available in Appendixes B.1, B.2 and B.3.

The intent of the Public Vehicles Act is to provide for and enforce the development and functioning of the bus industry in a manner consistent with the public utility principles which have been historically accepted as being appropriate. In summary, this means that the following criteria should be met:

(a) That service must be warranted by "public necessity and convenience" which is established through an adversary hearing process, with the onus on the applicant;

(b) That legitimate financial and economic target for each carrier is to retain viability;

(c) That carriers maintain their authorized services, levels of services, and fares;

(d) That the entry of new carriers, or the expansion of existing ones, be controlled so that the above three criteria are held in stable condition.

The above tests were established to provide an orderly development of the bus industry during a time of rapid economic and population growth. During this period new, profitable routes were becoming available faster than the bus companies could arrange to serve them. Since the mid-1970's the economic and environmental circumstances of carriers have so changed that hearings for new entries or even new routes are now a rarity. Instead, most of the hearings are concerned with changing charter rights, revising fares, tariffs, and the transfer of licences. In other words, whereas the classic regulator process was originally conceived to avoid the problem of supply exceeding demand, this is today only true with respect to charters and not to the provision of regular routes. In the last 10 years there have been only three or four major hearings when one carrier wished to share a market by instituting competing services. It is perhaps significant that in each of these cases, the applicants were private companies and the strongest objector was a publicly-owned carrier.

Many of those bus companies with only a few, short regular routes subsidize their scheduled services with profits earned from charter services. This in effect is a discriminatory tax on bus charter passengers but it is the only way at the present time that these services can be maintained. Other alternative solutions to the problem are now being examined. There are some charter companies who do not operate any regular routes and thus avoid the problem of cross-subsidization.

Turning to the implementation of the PVA through the OHTB, this has also led to some policy interpretations being incorporated into the hearing process by commissioners.

In a 1975 hearing it was stated by the OHTB that:

> "The Board must re-emphasize that the regular route services provided to the public are in most cases a losing financial proposition and, therefore, the licences depend on charter and special trip privileges annexed to their licences to subsidize the regular route service."

The details of this statement cannot be readily verified or measured due to scarcity of data, but in any event the OHTB is not rigorous in determining whether or not basic fares and increases are "fair and reasonable." The classic public utility posture is, however, that the average-total-revenue should equal average-total-costs, including some authorized rate of return on investment, and that fares may reflect differing costs between different types of service. Now the OHTB tends to base its evaluations upon pragmatic trends and carrier history rather than rigorous analysis. An applicant's pattern of behaviour with regards to fares, service, and stability of operations are the most important criterion upon which their application is judged.

The changing revenue base of bus operators and the possible opportunities for broader multimodal approaches, led the Minister in 1978 to issue a Public Vehicle Policy Statement #1 which was to be taken into consideration by the OHTB. It outlined four main objectives which are:

(a) The availability of an efficient interurban passenger bus and associated express freight service, reflecting public demand and the integration of such service with all other passenger transportation systems in Ontario;

(b) The need for competition to ensure the best service at the lowest cost to the public, while having regard to the economic impact on the licensed carriers;

(c) The ability and willingness of the applicant to provide service for which there is public demand, combining, as appropriate to the market to be served, marginal or submarginal and profitable services;

(d) The suitability of the applicant's proposed scale and style of operations in the market to be served."

In practice the OHTB has not actively responded to these Policy Statements even though in a 1970 hearing the examiner stated that "... there should be a complete spectrum of transportation services open to the general public." Lack of staff, precedents from past relationships and rulings, and unfamiliarity with rail services apparently inhibit the OHTB from acting on these Policy Statements.

6.1 Employment Standards Act

The working conditions and hours for industry at large, are set by the Employment Standards Act of Ontario, but special notice is taken of the requirements of the public transportation industry.

Permit No. 13 is a permit "granted to all employers engaged in the interurban and municipal transportation industry in the Province of Ontario." This permit modifies the Employment Standards Act as it relates to public transport so that standby and other non-operating hours spent by a driver are not included in calculation of the hours of work. The ability to adopt a 10-hour day is given to the employer. These provisions are necessary in dealing with morning and evening travel peaks and they also increase scheduling flexibility in allowing drivers to make continuous long-distance interurban runs. It is unreasonable to expect long-haul bus companies to change drivers in the countryside, say a half-hour's driving time from a town. Moreover, the unions have been advocating go and return schedules for drivers rather than overnight trips. Without the exemption this would be difficult, if not impossible, to accommodate.

The Federal Labour Code is primarily of interest in its difference to the Provincial Employment Standards Act. An Ontario public transportation company will fall under provincial legislation if a company's licences are only intraprovincial and under federal legislation if the company has interprovincial licences or a mix of intraprovincial and interprovincial licences.

The advantages or disadvantages of the Federal Labour Code over the Ontario Employment Standards Act are not clear. Some operators state an indifference to operation under either code. Others have split their companies into two corporations: one with intraprovincial licences, and the other with interprovincial licences, in order to avoid the application of the federal legislation to their local operations.

One comment received is that the issue does not tend to be a problem because of a lack of enforcement of the provisions of either Code. If this is the case, preference between one code and the other would shift on the basis of the enforcement of the code rather than the precise content of the legislation.

7.0 PROVINCIAL INVOLVEMENT IN OPERATING TRANSPORTATION SERVICE

7.1 The Ontario Northland Transportation Commission

In 1884 the Province of Ontario acquired its northern territories as a result of a federal Royal Commission delineating the Quebec - Ontario border. Before 1884 the disputed area had traditionally been connected to Montreal by trade. Even after the boundary decision was made many of the Ontario residents still found it more advantageous to trade with Montreal down the Ottawa River than to trade with Toronto and Southern Ontario. A further worry for the Ontario Government was the continuing settlement of Quebecers who tended to have a strong allegiance to their former province.

Survey reports in 1901 stated that:

> "It has been established beyond controversy that in the eastern part of the territory north of the Height of Land (Kirkland Lake) there is an immense area of excellent agricultural land ... equal in fertility to any in older Ontario ... the forests would enable Ontario to take a leading position in the ... pulp and paper-making industry."

In addition geologists spoke of the possibility of finding rich mineral resources similar to the nickel and copper deposits found near Sudbury.

Faced with the prospect that Northeastern Ontario was rapidly becoming a satellite of Montreal and that the Province was losing settlers to the Canadian and American West the Ontario Government made the decision that a railway had to be built into the Northeast. To the Province's disappointment no private capital was forthcoming to help build the railway. Most private financiers were scared away from the project because of the high cost other railways had incurred when building lines across the Canadian Shield. In addition the proposed route had few proven resources.

By 1902 the Government of Ontario could wait no longer so they made the bold step of deciding to build, own and operate their own railway. Officially the railway was to operate under a Commission which would report to the Premier of the Province.

The railway component of this Commission was originally known as the Temiskaming and Northern Ontario Railway, and was established "to open up New Ontario by truck colonization roads and railways in order to make homes for the sons of Ontario, who otherwise might seek a home in another Province or under a foreign flag."

The original plan for the railroad was to go from North Bay to Lake Temiskaming where a settlement of loyal British settlers lived and then through the Clay Belt to Cochrane. A possible

extension to James Bay was also contemplated. From North Bay people or goods could move east or west along the main Canadian Pacific line or southwards to Toronto and Lake Ontario. By 1905 the railway had reached New Liskeard and by the fall of 1908 it reached Cochrane. Arriving at Cochrane was important because the Federal Government was just starting to build their own transcontinental rail route across Northeastern Ontario and villages along the proposed route enjoyed a great boom of prosperity providing supplies for the new railroad.

This section of the railroad proved its supporters were right in building it because it brought large numbers of Ontario and Western European settlers into the area, it opened up valuable forest resources and it went through perhaps the richest mineral deposits anywhere in Canada.

The building of the line from Cochrane to Moosonee was postponed until the 1930's when make-work programs were needed. Premier Howard Ferguson wrote to George L. Lee, Chairman of the T and NO Commission, on July 29, 1930:

> "In view of the present unemployment situation I think this work should be continued this year. If we were to stop work now and turn away hundreds of men, it would only aggravate the present difficult labour situation."

From the beginning the Commission had been given powers far greater than those given to normal railways particularly in the field of multimodal operations. The following extracts from the current ONTC Act give a clear picture of the vested railway powers and their intent:

> "Subject to the approval and direction of the Lieutenant Governor in Council, the Commission may:
>
> (a) construct, equip, maintain and operate a line or lines of railway from thepresent northern terminal of the railway to some point on James Bay;
>
> (b) Purchase or otherwise acquire motor vehicles and trailers ..., aircraft, and lines of buses, coaches, trucks, and aircraft, and may operate, maintain, control, and manage such vehicles, trailers, aircraft, and lines for the purpose of carrying passengers and freight;
>
> (c) purchase or otherwise acquire, construct, complete, equip, maintain, and operate hotels, tourist resorts, restaurants, and lines of boats and vessels;

(d) purchase or otherwise acquire, construct, complete, equip, maintain, or operate such undertakings and provide such services in that part of Ontario that is served by the Commission, as the Commission may consider to be for the benefit of travelers therein or residents thereof;

(e) ... purchase land for and erect power houses, warehouses, elevators, docks, stations, workshops, garages, hangers, air harbours, and landing grounds, offices, and any other works necessary for the exercise of the powers conferred ... "

"The Lieutenant Governor in Council may, from time to time, authorize the Treasurer of Ontario to advance to the Commission out of the Consolidated Revenue Fund, such sums as may be considered necessary for the construction, maintenance, and operation of motor vehicles, trailers, aircraft, lines of buses, coaches, trucks, and aircraft and equipment, therefore, or other works of the Commission and all moneys so advanced shall be duly accounted for."

"The Commission may make regulations fixing the fares and tolls to be charged for all traffic carried and with respect to any telephone or telegraph lines operated by the Commission is herein authorized."

"The regulations so made shall be deemed to be of an administrative and not of a legislative nature."

"The Commission may from time to time, at its option, in lieu of expropriating land under any such general railway Act, expropriate such easements, rights of user and rights of support as is indicated in any notice to be given by the Commission in that behalf."

"The railway of the Commission, including any branch lines, spurs or sidings, may be carried along or across existing highways upon leave therefore having been first obtained from the Ontario Municipal Board and subject to the Expropriation Act ..."

"The Lieutenant Governor in council may, from time to time, by Order in Council transfer to the Commission for town sites, portions of the ungranted land of Ontario along the line of railway adjacent to stations or proposed stations ..."

The following clauses from the Act show the extent to which the Province may go and has gone to extend control of a Crown transportation company to those originally in the private sector and which it has felt necessary and desirable to support or takeover.

"The Commission, and any or all of the commissioners or any officer of the Commission designated by the Commission for that purpose, may hold the shares of the Nipissing Central Railway Company or of any company purchased or otherwise acquired or caused to be incorporated by the Commission under the authority of this Act, in trust for Ontario, and may exercise all the rights of shareholders in respect of the shares so held by them."

"The Commission may advance to the Nipissing Central Railway Company such sums as may be required, from time to time for, the maintenance and operation of the line of railway of the company, or for the purchase, construction, repair and maintenance of the equipment thereof."

"The Commission, either the approval of the Lieutenant Governor in Council, may advance to any company, purchased or otherwise acquired or caused to be incorporated by the Commission, such sums as may be required for the obligations and undertakings of the company."

"Subject to the approval of the Lieutenant Governor in Council, the Commission may borrow money, for carrying out its purpose and may issue bonds, debentures, notes or other securities to provide for the repayment of any moneys so borrowed and such securities may be charged upon and secured by the property, assets, rights, rents and revenues of the Commission present or future therein described and may be payable at such times and in such manner and at such place or places in Canada or elsewhere and may bear such interest as the Commission may consider proper."

Another part of the ONTC Act specifically excludes the bus operations of the Commission from the regulatory requirements of the Public Vehicles Act. There appear to be two possible reasons for this. One is that such regulation would be redundant in that there may not be a private carrier serving the route selected for ONTC implementation and, in this case, the Province has already deemed a "public necessity and convenience" by virtue of instituting the service. The second reason could be due to a wish to avoid an adversary hearing with a private carrier which might already be serving all or part of the route because the Commission's actions indicated an economic and social concern greater than the basic precedents of "necessity and convenience". If this latter reason were the case, then it constituted a provincial recognition of the validity of broader criteria to meet larger objectives. In any event, private carriers wishing to compete with ONTC bus services would still have to follow the regulatory path.

Since 1905 Ontario Northland Transportation Commission has operated a passenger and freight rail service. In 1936 the Commission started operating buses along routes not served by

rail and in 1946 it added boat service on Lake Nipissing. By 1960 truck freight (Star Transfer), airline service (norOntair) and ferry service to Manitoulin Island had been added to Ontario Northland. One of the oldest and still most profitable enterprises run by the Commission is their telecommunications network consisting of telephone and telegraph lines, special computer lines, and radio and microwave stations.

7.2 Commuter Services Act

In 1970 the Ontario Government again became an active participant in public transportation with the passing of the Commuter Services Act. This Act is intermodal in nature and is intended to apply throughout the Province.

An important departure from the approach of the ONTC Act is that the construction and ownership of a railway is no longer of concern. Instead, the emphasis is upon powers which would allow the Province to plan and financially support services operated by existing railways. The financial involvement authorized falls just short of actually owning and operating a railway, and the primary constraint appears to be that the employment of personnel to operate rolling stock is not specifically authorized.

Essentially, the Act enpowers the Province to initiate public transportation commuter services to and from any municipality. The Webster's Dictionary defines "commute" as "...to travel back and forth regularly..." and the word "regularly" is defined as "...recurring at fixed or uniform intervals."

Commuting is most commonly associated with work trips, but not always. People who work in a city but have a permanent home in the country or another city speak of commuting home for the weekend. Regular trips made by rural residents to a larger community for shopping purposes could fall within this definition even if such trips occur only once per week. In fact TATOA, which functions under the powers of this Act, operates services for that very purpose. There are also no distance limitations defined, so that a businessman travelling regularly London - Toronto for meetings twice per week could be considered as commuting. Thus, it is possible to envisage this Act being applicable to services to and from or between a number of selected municipalities for a variety of travel purposes.

The Commuter Services Act allows considerable flexibility in both scope and arrangement of the delegation of powers and the mechanics of implementation of services. It may be done in its entirety directly by the Province, or indirectly through existing or new public or private organizations, or in any combination.

The most important parts of the Act with respect to the report are as follows:

"Her Majesty the Queen in right of the Province of Ontario, represented by the Minister may,

(a) establish and operate; and

(b) with the approval of the Lieutenant Governor in Council, enter into agreements with Canadian National Railways and any other corporation or individual, with respect to any matter of thing having as its object the establishment and operation, or either of them, of commuter services to serve any one or more areas in Ontario."

"The Minister may,

(a) acquire by purchase, lease or otherwise any rolling stock, equipment, apparatus or thing; and

(b) acquire by purchase, lease or otherwise, or expropriate any land or any interest in land, that may be required for the establishment and operation, of any commuter service that is or is to be provided under section 3."

"The Lieutenant Governor in Council may make regulations,

(a) prohibiting or regulating the use of any land or any interest in land acquired under subsection 1 of section 4 and prohibiting or regulating vehicular traffic and pedestrian traffic on any such land or interest in land;

(b) requiring and providing for the issue of permits and licences and providing for the granting of rights in respect of the use of any such land or interest in land, and providing for the revocation of any such permit, licence or right;

(c) prescribing the fees or rentals payable for any permit, licence or right issued or granted in respect of any such land or interest in land;

(d) prescribing fares that shall be charged and collected for any service;

(e) governing the terms and conditions upon which tickets may be sold;

(f) governing the conduct of passengers and for refusing passage to persons who do not comply with the regulations or the terms and conditions upon which tickets are sold."

7.3 Toronto Area Transit Operating Authority

In 1974 multimodal transit operation and coordination was established in the Toronto region through "An Act to establish the Toronto Area Transit Operating Authority." This Act transferred to the operational jurisdiction of TATOA, some services which had been established under the powers of the Commuter Services Act. The TATOA Act also included some clauses on land rights and ticketing which appeared in the prior Act.

The criteria within the TATOA Act to identify the objectives of TATOA broadens the scope much further:

> "... to service the needs of persons requiring transportation as passengers ...", and "... in order that the public interest may be serviced ..."

These phrases distinguish from the "necessity and convenience" criteria in several important ways. They soften or remove the requirement to measure and debate "necessity", and also shift such a consideration from a public hearing environment to a predominantly institutionalized administrative and managerial process. The omission of "convenience" removes the mandatory onus of positive financial consequence and replaces it with a variability which is determined by the circumstances surrounding each case. There was also a slight but important broadening of the operation strategies. The CSA had confined itself to "...establish and operate ...", whereas under TATOA, it became "...design, establish and operate or cause to be operated ..."

A policy interpretation, which may set a useful precedent, is the short-term leasing of provincially owned TATOA buses to other carriers for charter purposes. Perhaps the largest area of TATOA policy uncertainty, and which could also have meaning for intercity considerations, has been the apparent difficulties in simultaneously attaining area-wide coordination and service operation objectives.

The need for a re-evaluation of TATOA policies in the light of practical experience, has led to a special report to the Minister by the Deputy Minister which included the following summary:

> "The TATOA Act should be amended to include a policy statement which clearly outlines the relationship of TATOA to broader concerns and issues of government. Within this should be the clear stipulation that the government, in its wisdom, can avail itself of the TATOA infrastructure and service in order to advance some specified public good."

Appendix A

A.0 FEDERAL LEGISLATION

A.1 British North America Act

The British North America Act (BNA) provides the basis for the division of power between the federal and provincial governments. Ideally, services of national interest fall under federal jurisdiction while those of regional interest fall under provincial jurisdiction. The practice that has evolved from this initial desire has been less pure in the sense that jurisdiction has developed along modal lines, rather than over areas of interest. Railway building proceeded to join together the provinces...with regional services fleshing out the system later, so that a highly detailed federal control was established over rail. A similar situation exists for marine and air. For the road system there was a bottom-up development, serving regions first and then providing links between regions. This led to provincial development of all the institutions of control.

The Winner Decision of 1954 marked a major clarification of federal responsibilities relating to highway carriage. Israel Winner, under the Mackenzie Coach Line was authorized by the Motor Carrier Board of New Brunswick to operate a route through New Brunswick (connecting Boston, Mass., and Glace Bay, N.S.) but was denied permission to carry any passengers who were both picked-up and discharged within New Brunswick. The ability of the Province to impose an operating condition prohibiting local carriage in conjunction with the through carriage was disputed to the Privy Council as final arbitrator of the BNA Act. The BNA Act stated that a provincial legislature may exclusively make laws in relation to local works and undertakings other than those connecting the Province with any other province or extending beyond the limits of the province. The primary findings of the Privy Council were:

> That while the roads were provided by the Province the undertaking of the bus company to carry passengers beyond the province was sufficient to place the regulatory responsibility on the Dominion; that the through and local services were "one and indivisible" so that the Province could not regulate local aspects of an interprovincial service.

This decision could be construed as invalidating any provincial regulation of carriers with operations extending over provincial boundaries. A large regulatory vacuum was created that was filled by the Motor Vehicle Transport Act of 1954.

A.2 The Motor Vehicle Transport Act

The Winner decision removed much of the regulation under which the intercity bus operators (and truck operators) carried out business. The Motor Vehicle Transport Act was the reaction of the federal government to this situation. It aimed at preserving the status quo by authorizing provincial boards as federal boards and giving their licences the constitutional authority of federal licences.

Whenever a licence is required for a local undertaking, this Act makes it an offence to operate that service as a part of an extra-provincial undertaking unless the appropriate licence is held. The authority to issue this licence is vested in the provincial boards.

While authority was retained by the provinces, the Act also made provision for some federal regulation by providing that federal cabinet had the power to exempt any extra-provincial undertaking from the requirement of a licence from a provincial transport board. Further legislation in The National Transportation Act covers any exempted services.

A.3 National Transportation Act

"An Act to define and implement a national transportation policy for Canada."

The National Transportation Act (NTA) of 1967 is the cornerstone of federal legislation on transportation, not in the sense that it is chronologically the first, but in the sense that it contains the policies that administrative organizations are constrained to follow. In summary, the Act: sets out policy in its preamble; establishes the Canadian Transport Commission in Part I; regulates pipelines (not herein discussed) in Part II; and, provides a framework (not implemented) for federal control over interprovincial highway carriage.

a) Preamble

The Federal transportation policies as set out in this Act may be summarized as follows:

i) A Regulation to permit free competition among modes.

ii) A mode should reasonably bear the cost of public investment in that mode.

iii) Modes should be compensated for socially desirable but financially uneconomic services.

iv) Rates should be cost-based.

The focus of federal policy is in competition between, rather than within modes. The competitive ability is enhanced and rationalized by: the recovery of public investment from that mode; compensation for uneconomic service so that cross subsidization is reduced; and prohibition of non-cost factors (monopoly powers) as a factor in rate-setting. There has been some debate as to the actual achievement of these objectives. There is also reason for considerable scepticism as to their useful effectiveness.They are, however, the stated policies.

b) Part 1

In 1967 the Board of Transport Commissioners, with powers over the rail mode, the Air Transport Board, and the Canadian Maritime Commission was abolished and the personnel transferred to the Canadian Transport Commission (CTC). The Commission took over responsibility for the carrying out of regulatory matters over the rail, air and water modes. Much of the thrust behind the formation of the Commission was the development of a comprehensive body that could make decisions on a modal basis but in awareness of the intermodal implications of those decisions.

The CTC is a semi-independent body reporting to the Minister of Transport. Its duties may be summarized as follows:

i) to coordinate and harmonize all carriers (water, air, rail, pipeline and extra-provincial motor transport); to interpret the legislation of the Railway Act, Aeronautics Act and Transport Act;

ii) to administer: regulation and licencing, rates and tariffs, and subsidies voted by Parliament;

iii) to undertake study and research into all modes and participate in the work of other interested organizations;

iv) to establish economic standards and criteria for allocating federal investment in modes; to recommend measures to the Minister of Transport and

v) to advise on the balance between expenditure programs and methods to develop revenue.

The CTC, therefore, is a body with regulatory, advisory and investigatory powers. Its primary impacts on surface public passenger transportation come from the Railway Act's powers over all rail passenger movements and over extra-provincial highway passenger movements under the Motor Vehicles Transport Act.

c) Part III

While the NTA has been passed into law, Part III has not been fully implemented. It has been applied only to the "Road Cruiser" service in Newfoundland which was instituted to allow rail passenger service abandonment by Canadian National. This service is operated by C.N., wholly within Newfoundland in replacement of a rail service which had been federally authorized under the Rail Act.
If Part III were implemented on a general basis, this might entail the following requirements.

Licences to all extra-provincial carriers could be issued only under conditions of public convenience and necessity as determined by the CTC.

i) CTC may attach routes and conditions to licences.

ii) All tolls must be filed with CTC.

iii) Applications may be altered or denied.

iv) No free or reduced rate transport is allowed without CTC permission.

A.4 Railway Act

Intercity rail passenger transportation at present generally involves two companies, a railroad that is primarily a goods movement company that provides trackage, operation, and influences, schedules, and VIA Rail Canada Inc which provides the passenger related rolling stock, ticketing and train crew. The intercity movements, with the exception of a few remote rail captive communities, are competivive with provincially regulated bus companies.

Legislation governing the rail mode rests almost exclusively with the federal government under the Railway Act (interpreted by the CTC) and is so comprehensive that other jurisdictions are allowed only a minor degree of control. It is important to recognize, however, that VIA is now responsible for passenger services and that their jurisdictional relationship to CTC is uncertain, and may not be subject to CTC ruling at all with respect to services.

Included under the Railway Act are the rights of the company with respect to ownership of right-of-way, safety regulation, conditions of carriage, necessity to provide carriage, etc. Once a passenger service is initiated, its abandonment is permitted only after referral to the CTC. The steps to be followed prior to an abandonment of service are listed below.

a) Application is submitted to the CTC with a statement of costs and revenues and public notice is given to the area affected.

b) If the operation does not constitute a financial loss, the application is rejected. If the operation does constitute a financial loss to the carrier, hearings are called to allow all interested persons to express their view and to determine whether or not the service discontinuance will be accepted. Criteria for acceptance or rejection of the application are:

   i) actual financial losses attributable to passenger service;

   ii) alternate transportation facilities, present and potential;

   iii) probable effect on other lines and carriers;

   iv) future transportation needs.

c) If discontinuance is allowed, it may occur from 30 days to one year from the date of the order; if rejected, no new application will be entertained for five years.

d) If discontinuance of an unprofitable service is rejected, an application for a subsidy to cover the operating loss may be made.

While there are several obstacles in the way of discontinuance, the institution of new services remains comparatively simple.

Rates and tariffs for passenger carriage are filed with the CTC as Standard Special Passenger Tariffs. The standard tariffs "specify the maximum mileage or tolls to be charged for passengers for all distances covered by the company's railway", while the special tariffs record" every case where such tolls are lower than the tolls specified in the company's Standard Passenger Tariffs." These tolls are to be "just and reasonable". In cases where the CTC finds a toll unjust or unreasonable, they may disallow the tariff or any portion of it. The Commission may then prescribe a tariff or require that the company submit a satisfactory one.

Provision is made for individuals to appeal tariffs set by the rail companies and authorized by the CTC. An application is made to the Commission for leave to appeal a tariff and if the Commission is satisfied a prima facie case had been made, leave to appeal is granted and the Commission carries out any investigation it considers warranted. Considerations in the investigation include:

a) the financial ability of the carrier to provide the service;

b) the effect of the tariff on services offered to the public;

c) railway control of alternative transportation.

If, at a hearing, the tariff is found to be prejudiced to the public interest, the CTC may make an order to remove the prejudicial feature.

Appendix B

B.0 Provincial Legislation

The British North America Act divided jurisdictional responsibility between the federal and provincial governments. The actual division of power has proceeded evolutionarily on the basis of legal precedents refining the understanding of the BNA Act. Municipal governments are "creatures of the province" as they result from provincial legislation and exercise authority that is delegated to them by the provincial governments. This system of delegation rather than constitutional authority is important in that the ultimate municipal authority rests with the province and may be resolved, rescinded, or modified according to the needs of changing circumstances.

Most of Ontario's Legislation regarding public transportation concerns highway carriage. The Public Vehicles Act requires licencing of all carriers on a point to point basis. These licences are not exclusive franchises but come close to the granting of monopoly powers. Licences are issued by MTC under advice from the Ontario Highway Transport Board (operations of the Board are governed by the Statutory Powers Procedures Act). Beyond the operating licence, driver and vehicle licences are required under the Highway Traffic Act and working conditions governed by the Employment Standards Act. The provincial government reserves the right to enter the public transportation field by ownership of facilities or contract with private companies through the Commuter Services Act and Bill 115 (Toronto Area Transit Operating Authority).

Powers to regulate and control public transportation are granted to the municipalities by provincial legislation. These powers are granted through the Municipal Act, which is outlined later in this Appendix. Provision for assistance in financing of municipal plans is made under the Public Transportation and Highway Improvements Act. The authority of the municipalities over public transportation is relatively uniform, although there is considerable difference in the powers of regional municipalities.

B.1 Ontario Highway Transport Board Act

The Ontario Highway Transport Board is established by a separate Act of the provincial legislature. The Board is composed of a minimum of three members appointed by the Lieutenant Governor in Council. Two members of the Board constitute a quorum.

The Board serves as an advisory investigatory body to the Minister of Transportation and Communications under the Public Vehicles Act and under the Public Commercial Vehicles Act. In this capacity it has the power to hold hearings, summon witnesses, and require information from transportation companies. Witness fees are paid on the same schedule as the Supreme Court.

In addition to the powers to review, the Board may at "any time rehear, amend, review and revoke decisions, orders, directions, certificates or approval" that were previously issued by the Board.

Petitions against Board rulings may be made to the Lieutenant Governor in Council, although this course is seldom followed.

B.2 Statutory Powers Procedure Act

This is "an Act to provide procedures governing the exercise of statutory power granted to tribunals by the Legislature wherein the rights, duties or privileges of persons are to be decided at a meeting. "Whereas the OHTB is a body with statutory powers, this Act comes into force to govern the procedures of the Board.

B.3 Public Vehicles Act

The Public Vehicles Act has been in existence since 1920 when the Ontario Government decided to regulate;

> "...any vehicle operated by or on behalf of a person carrying upon the public highway the business of a public carrier of passengers and operating between fixed termini or at stated intervals..."

Each "public vehicle" had to obtain an annual operating licence from the Department of Highways. Before this licence would be granted the public vehicle operator had to file an approved list of tariffs and tolls and had to agree to the maximum number of passengers each vehicle could carry at any one time.

With the court decision regarding the Winner's Case in New Brunswick and the subsequent passing of the federal Motor Vehicle Transportation Act the Province of Ontario had to rewrite the Public Vehicles Act. The current Act dating from 1955 splits the responsibility of regulating the bus industry between the OHTB and the Minister of Transportation and Communications and his Ministry.

a) Application for an operating licence must be made to the MTC.

b) The OHTB then holds a hearing to determine whether or not a certificate to the effect that public necessity and convenience warrants the issuing of a licence.

c) If a certificate is issued, then the Minister may issue a licence.

d) The OHTB may prescribe governing terms and conditions in a certificate.

e) A licence holder must file with the M.T.C. a tariff or fares which must then be approved by the Minister as "fair and reasonable" prior to implementation.

f) The Minister may indicate a refusal to approve a submitted tariff or fares and he may at any time indicate a desire to revise a tariff. In either case if the applicant does not consent then the matter must be referred to the OHTB although the findings are not binding on the Minister.

g) If the licence authorizes a particular scheduled service then it should not be discontinued until after written notice has been given to the Minister.

h) The renewal of the licence automatically occurs when the vehicle licences are renewed.

i) The Minister may suspend or cancel a licence if after 30 days there has been a failure to provide service, financial incompatibility, illegalities, or failure to comply with licence conditions.

The requirements for a licence is clearly stated.

"Notwithstanding the provisions of any private Act, no person shall operate a public vehicle,

a) except under an operating licence; and

b) in contravention of the terms and conditions of that licence."

B.4 Public Transportation and Highway Improvement Act

The powers of municipalities to provide public transportation are granted to the municipalities through the Municipal Act and specific regional municipal Acts. The Public Transportation and Highway Improvement Act provides for a provincial subsidy for the installation, development, and operation of a public transport system within the municipality. This Act originally called the Highway Improvement Act was first legislated in 1926 and went through a great many changes until it reached its present form and title in 1971.

Under this Act financial assistance may be given to the municipalities for:

a) the purchase or rental, operation and maintenance of public transportation vehicles;

b) the acquisition of land for public transportation system and its support facilities;

c) agreements for the supply of public transportation;

d) any other "equipment, works and services" approved by the Minister.

The financial assistance is provided "out of money allocated to the municipality at the same rate and in the same manner as expenditures properly chargeable to road improvements."

Other Acts provide the municipalities with the authority to institute public transport services. This Act provides the financial support necessary for the exercise of these powers.

B.5 Municipal Act

The Municipal Act is one of the oldest Acts in Ontario dating back to 1857. While this Act has changed in context over the years its basic purpose of outlining the powers and responsibilities of municipalities with regard to local transportation infrastructure and public transit services remain unchanged to this day.

The first power of the municipalities, in regard to public transit services, is their ability to franchise an operator with exclusive rights to operate a public transportation service within the municipality. The municipality is empowered to enter into an agreement "with any person for a period not exceeding ten years for granting to such persons the exclusive right to maintain and operate buses, for the conveyance of passengers in a defined area of the municipality, over such highways in the area and at such rates for fares and charges and on such other terms and conditions as may be thought proper." Qualifications to the power of franchise include the following.

a) The franchise does not affect a licence under the Public Vehicles Act.

b) Fares may be changed only once a year and then only on application to the Municipal Board.

c) Any deficit may be covered by a special rate levied on property.

d) Assent of Municipal electors in the defined area is needed.

The power of franchise is used by some municipalities but the more common technique is the direct establishment of the service. By-laws may be passed "for acquiring, establishing, maintaining and operating a public bus transportation system within the Municipality." The power extends to the fixing of fares and the making of regulations for the operation and control of the system. If the bus system is to operate into any adjoining municipality, the approval of that municipality is necessary and provision is made for the entering into agreement with adjoining municipalities. However, the system may provide "for the transportation and conveyance of passengers throughout Ontario, whether by charter trips or otherwise" as long as the arrangement is not in contravention of the Public Vehicles Act.

A limit on the exclusive ability to provide bus transportation occurs in that by-laws may not "affect the right of any public, separate or secondary school board or board of education to provide transportation for pupils."

In addition to franchising and operating powers, the municipality also maintains licensing powers over the operator of any for-hire vehicles, in addition to buses within the municipality. By-law regulation of highways and traffic is also permissible in so far as it does not conflict with the Highway Traffic Act.

B.6 Regional Municipalities

Regional municipalities differ in their control of public transportation within their boundaries. The widest powers are granted to the more recently incorporated regional municipalities; Durham, Haldimand Norfolk, Halton, Hamilton-Wentworth, and Peel. These regional municipalities all have public transport powers written into their charters.

This is done by stating that the regional corporation shall be considered a local municipality for the purposes of Paragraph 90, Section 354 of the Municipal Act (which is the paragraph that empowers the local municipality to create and operate a local transit system). If this power is exercised by the regional corporation, the system of the regional corporation supersedes those of the area municipalities which are incorporated into it. This ability to regionalize the transit systems of the Area Municipalities, however, has encountered difficulties in implementation. Area municipalities with functioning local systems are understandably adverse to the sense of having their investment "expropriated." Conversely, a regional municipality may be unwilling to burden itself with the debt of an area municipality occurring from investment in a transit system.

Other older regional municipalities did not include the issue of public transportation in their charters which allows the continued function of the local municipalities under full powers (regarding public transportation) of the Municipal Act. These regional municipalities charters, however, may be amended to include public transportation powers. Such amendments occurred in the charters of the Regional Municipalities of Niagara and Ottawa- Carleton.

The Regional Municipality of Niagara Act was augmented to provide for some control of public transport. Power was given to the Niagara Policy Board "for licencing, regulating and governing teamsters, charters, draymen, owners and drivers of cabs, buses, motor or other vehicles used for hire or any class of classes thereof; for establishing the rates or fares to be charged by the owners or drivers of such vehicles within an area municipality or to a point not more than three miles beyond its limits." Provision is made for the requirement of insurance and revoking of licences. All licence fees are payable to the Regional Corporation.

The Regional Municipality of Ottawa-Carleton Act was augmented in 1972 with considerable broader powers than those granted to Niagara. This Act establishes the Ottawa-Carleton Regional Transportation Commission to supersede the Ottawa Transportation Commission. Powers are granted to operate and extend the regional public transportation system and limitations imposed by the Municipal Franchises Act are removed. "The Regional Corporation has and may exercise through the Regional Area all the powers heretofore or hereafter conferred by any general Act upon a municipal corporation and by any special Act upon any area municipality or local board thereof with respect to passenger transport."

BACKGROUND PERSPECTIVES

TO INTERCITY PUBLIC TRANSPORTATION

IN ONTARIO

Volume 2: Energy Consumption of Intercity Passenger Transportation Modes

Ministry of Transportation & Communications
Intercity Transportation Policy Office
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ENERGY CONSUMPTION OF INTERCITY PASSENGER TRANSPORTATION MODES

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1.0 INTRODUCTION

In the 1980s, energy will be an increasingly important consideration to the public, the transportation operators, and various levels of government. Attention will focus on both the future price and the future availability of various energy supplies, particularly petroleum energy. At present the intercity transportation system in Ontario is virtually 100% dependent on various petroleum products for vehicle propulsion.

Energy and its influence are, therefore, important components of a perspective on intercity passenger transportation. This paper will highlight the current discussion on energy consumption, provide a background for the non-energy specialist, point out some of the difficulties in estimating energy consumption and document, as best as possible, the current and potential energy productivity of the various intercity transportation modes.

1.1 Background To Transportation Energy Consumption

Energy for use in industry and transportation can be stored in many forms with some of the common ones being coal, crude oil, natural gas and electricity. The first three; coal, oil and gas are classified as primary energy forms, meaning they have not been processed, converted, and transported to a useable form and location. Electricity, on the other hand, is classified as secondary energy since it is generated from a primary energy source, typically water-power (hydro-generated) or uranium, coal, oil or gas (thermal-generated). Secondary energy represent the energy available to the consumer. Tables 1-1 and 1-2 respectively show Ontario's primary energy consumption and secondary energy demand by sector for 1980 respectively.

Transportation accounts for 27% of the secondary energy used in Ontario. This energy comes almost entirely (99%) from oil which makes the transportation sector highly vulnerable to changes in both petroleum price and availability. Petroleum fuels are of vital importance to the transportation industry because they embody two qualities not found in most other fuels; they are highly concentrated and extremely portable. As most alternative fuels either lack density or easy portability, it is unlikely that petroleum will be significantly replaced by electric batteries, hydrogen, or other fuels in the near future. Figure 1-1 shows the dominance of the transportation sector in terms of oil consumption in Ontario.

The Ontario Ministry of Energy has prepared some estimates of the 1980 secondary energy use by transport sector in Ontario, as shown in Table 1-3. Passenger transportation is expected to consume 64% of the total transportation energy, with freight consuming the remaining 36%. The table also shows the dominance of the automobile in terms of energy consumption - 56% of the

total. Trucking is the second largest user,consuming 28% of the total transportation energy followed by air (6%), rail (5%), and bus (1%). Even if only intercity passenger movements are included automobiles continue to dominate the energy market consuming 74% of the total energy spent on transportation followed by air at 24%. Bus and rail together only account for 2% of the energy consumed by intercity passenger transportation.

Table 1.1

PRIMARY ENERGY CONSUMPTION IN ONTARIO 1980

URANIUM	12%
WATER-POWER	13%
COAL	14%
NATURAL GAS	22%
CRUDE OIL	39%
TOTAL CONSUMPTION:	3240 TERA JOULES (558 MILLION BARRELS OF OIL EQUIVALENT)

Table 1.2

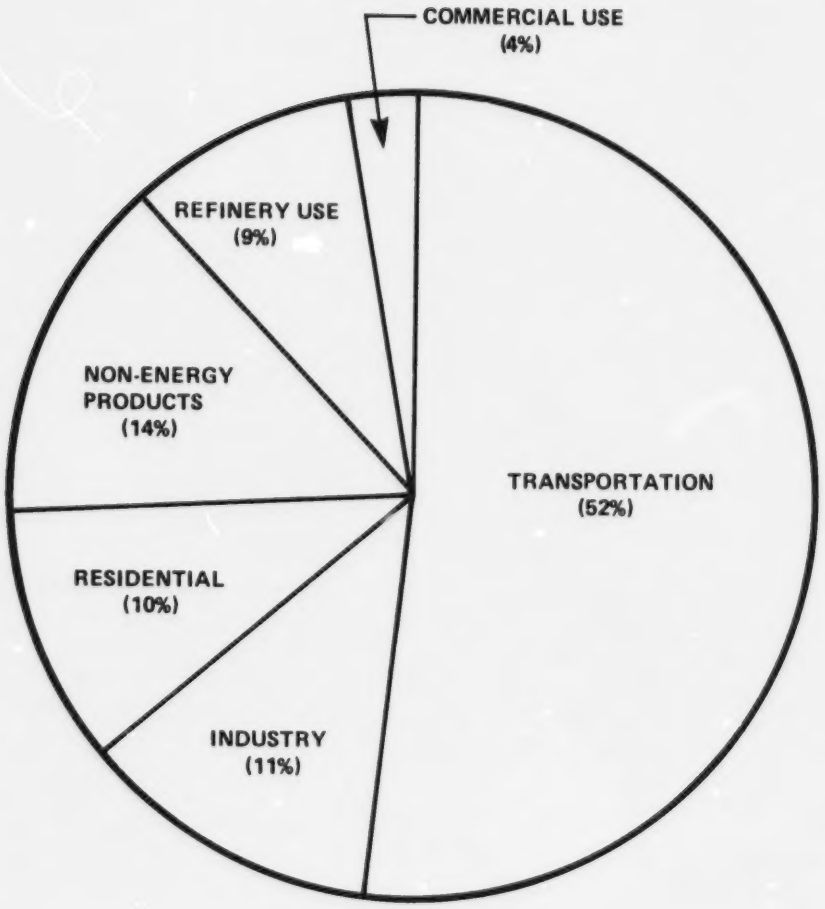
SECONDARY ENERGY DEMAND IN ONTARIO BY SECTION 1980

COMMERCIAL	13%
RESIDENTIAL	21%
TRANSPORTATION	27%
INDUSTRIAL	39%

Source: Ontario Energy Review, Ministry of Energy, Ontario, Sept. 1983

Figure 1.1

OIL CONSUMPTION BY PRINCIPAL USE (1980) IN ONTARIO



SOURCE: ONTARIO MINISTRY OF ENERGY,
ONTARIO ENERGY REVIEW, SEPT. 1983

TABLE 1-3

ESTIMATED 1980 ENERGY CONSUMPTION IN TERA JOULES (TJ) FOR TRANSPORTATION IN ONTARIO

	Passenger		Freight			Total	
Mode	Intercity	Urban	General	Bulk	Urban	Btu	% Share
Rail	2.3	.3	19.9	7.6		30.2	5.0
Bus	1.2	5.0				6.2	1.0
Air	36.5					36.5	6.2
Auto	115.4	206.3				321.7	56.0
Subway/ Streetcar		.66				.66	0.1
Truck			70.3		91.4	161.6	27.9
Marine			1.5	15.4		16.9	
TOTAL	155.4	212.3	91.7	23.0	91.4	573.9	
%	27.0	37.0	16.0	4.0	16.0		100

Source: Ontario Ministry of Energy, 1983

2.0 APPROACHES TO ENERGY MEASUREMENT

2.1 Energy Units

Transportation is the moving of an object or person from one location to another. In performing this movement certain forces such as gravity or friction must be overcome. The overcoming of the forces requires work, which in turn requires an expenditure of energy. Energy is the ability to do work.

Energy is available in many forms, chemical, nuclear, kinetic and thermal. However, it is the heat value contained in fuels (thermal energy) that is most useful for the propulsion of vehicles. The heat value contained in the fuel is commonly expressed in terms of British Thermal Units (Btu) or Joules (J) in the Imperial and International Systems, respectively. To facilitate an understanding by a layman, energy consumption is frequently expressed as a volume or a mass, such as gallons of gas or equivalent barrels of. This can reduce all fuels to a common denominator, thus permitting a multi-fuel analysis. For a more complete list of the energy content of fuels and conversion factors see Appendix B.

2.2 Energy Measurement Concepts

There are several common forms for expressing the usage of energy. Each of these attempts to express the rate at which energy is consumed in relation to the resulting transportation service.

One common measure of energy usage is efficiency which may be defined as:

$$\text{Transportation Efficiency} = \frac{\text{Transportation Output}}{\text{Energy Input}}$$

$$= \frac{\text{Seat miles or seat-km}}{\text{Btu or Joules}}$$

Transportation efficiency should take into account the effect of route circuity (the ratio of distance travelled to straight line distance) to permit the comparison of various alternatives or routes to be made on the same basis. The transportation efficiency equation is then expressed as:

$$\text{Transportation Efficiency} = \frac{\text{Effective Seat Miles (km)}}{\text{Btu (Joules)}}$$

Transportation productivity, allows the analyst or planner to distinguish between the transportation service offered (seat-miles) and the transportation services consumed (passenger-miles). It is expressed as:

$$\text{Transportation Productivity} = \frac{\text{Effective Passenger Miles (km)}}{\text{Btu (Joules)}}$$

Energy Intensity (EI) is the amount of energy consumed per unit of transport work and can be generally defined as:

$$\text{Energy Intensity (EI)} = \frac{\text{Energy Input}}{\text{Transportation Output}}$$

$$= \frac{1}{\text{Transportation Efficiency}}$$

The terms efficiency, productivity and intensity have been used interchangeably in some studies. This reflects the nature of energy studies, with the lack of universal norms.

2.3 Energy Measures

Although the concepts of energy efficiency or energy intensity are straightforward, difficulties are encountered when estimating these terms. What is meant by transportation output or energy input?

Transportation output could be measured in terms of vehicle-km, seat-km or passenger-km, where distance could represent the route distance, the great circle or straight line distance. It may include or exclude access, egress and back haul distances.

Similarly there are several ways to measure the energy used in a transportation system. Various studies have used one or more of the following forms of energy:

- Direct
- Indirect
- Primary
- Secondary
- Avoidable
- Non-Avoidable
- Total

There are some significant differences between these forms which a planner should be aware of. The following represents brief explanation of each of the energy forms.

DIRECT ENERGY: Energy consumed in powering a vehicle.

INDIRECT ENERGY: Energy required to manufacture and maintain the vehicles and to construct, operate and maintain the infrastructure.

PRIMARY ENERGY: Energy available to the final consumer (secondary energy) plus conversion losses, transportation or transmission energy and wastes used by the energy supply industries themselves.

SECONDARY ENERGY: This is similar to direct energy in that it expresses the energy used in the transportation system.

AVOIDABLE ENERGY: This includes the direct energy used to power the vehicle, the energy used to manufacture and maintain the vehicle, and the energy used in refining and transporting the fuel for use in the transportation system. However, it does not include the energy used to construct the infrastructure.

NON-AVOIDABLE ENERGY: This is the energy already used in the construction of the transportation infrastructure and cannot be recovered if the transportation service was discontinued. In some cases rolling stock can be included in this list if it cannot be modified or sold for other uses.

2.4 Measurement Approach

In addition to the above differences in "what" is being measured, there are different approaches on "how" to measure the energy intensity of various intercity transportation modes. First there is the aggregate approach, shown below, which is simple and straightforward.

$$EI = \frac{\text{Fuel used (expressed in Joules) for a particular year}}{\text{Passenger output for the same year}}$$

The aggregate approach can be used for gross system or national estimates and the input data can be established without much effort. However, it has several shortcomings. Since it documents only the total fuel consumption for a transportation system, it does not lend itself to providing a basis for determining the energy intensity of individual routes, services or components of a service. Aspects, such as consumption due to vehicle idling, circuitous routes, aerodynamics or rolling resistance of various equipment types can not be identified. This aggregate approach is therefore often not applicable for an analysis of a particular situation, such as improving the energy efficiency of a certain route.

The alternate method is the disaggregate approach which relies on specific information about individual system components and routes, such as the vehicle performance, the routing (terrain), trip characteristics and fuel consumption. Based on detailed measures, and several layers of mathematical relationships, an estimated output is obtained. This approach, is sensitive to vehicle and environmental characteristics and therefore, is more suitable for estimating differences in various vehicles or systems, given a particular environment. However, it is labour intensive and requires a significant amount of data.

For various reasons, including a lack of data, many studies will use a compromise between the aggregate and disaggregate approaches to measuring the energy intensity of various alternatives.

3.0 Factors Affecting Energy Productivity

As previously mentioned, there can be a variety of factors which affect the energy productivity of a vehicle or transportation system. For direct energy consumption, these factors can be grouped into three categories: service related, traffic related, and facility related. Estimates of indirect energy consumption would have to consider five broad sources of variation including the vehicle manufacture, vehicle maintenance, facility construction, facility operation/maintenance, and peripheral effects.

To simplify the discussion the following sections will deal with potential sources of variation related to direct energy consumption.

3.1 Service Factors Affecting Direct Energy Productivity

The most important service factor affecting energy productivity is the load factor, which expresses the ratio of usage to capacity. Since most transportation vehicles are very heavy in relation to their passenger loads, the addition of extra passengers has practically no impact on the energy consumption, while lowering significantly the energy use per passenger. Thus a bus, train or airplane would be much more energy productive at 100% load factor than at 50% load factor, although the energy consumption would be virtually identical.

Seating density is a service factor directly affecting energy productivity under certain conditions. Many transportation operators have the flexibility to alter the seating density on selected vehicles to increase revenue and/or to cater to selected markets. The actual seating density or vehicle capacity should be reviewed when comparing service alternatives and load factors.

Caution is advised when considering load factors. Within a mode there is significant variation in the load factor by route, time of the day, week, or season. The load factor should reflect the situation and level of detail required for each analysis.

3.2 Traffic Factors Affecting Direct Energy Productivity

There are numerous traffic factors, depending on the transportation mode, which will affect the energy productivity of that mode. These could include the following items:

- volume of traffic,
- speed,
- distance,
- composition of vehicle types,
- characteristics of traffic flow,
- environmental conditions including wind and temperature,
- idling.

Heavier traffic volumes can reduce energy productivity by causing speed changes and lower than optimum operating conditions. Under very heavy traffic conditions, which result in a traffic breakdown, the traffic flow and hence energy productivity tends toward zero, creating inefficiencies. Traffic volume, particularly on highways has a direct bearing on average vehicle speed.

As a general rule, there is an optimum operating speed for energy efficiency. As speed increases, the drag forces increase, resulting in a greater rate of energy consumption. Figure 3.1 shows the fuel consumption at constant speed for automobile travel. Recently, major airlines and highway regulators have reduced the maximum speeds in an effort to reduce fuel consumption.

Trip distance is a very significant factor affecting the energy intensity for passenger transportation, particularly for air travel. More energy is generally expended in accelerating and decelerating than in the cruising mode; therefore, the longer the cruising portion of the total journey, the lower the relative energy intensity. Figure 3.2 shows the energy intensity vs. trip length for several commercial aircraft. The frequency of stops also affects the energy intensity of passenger rail services as a multi-stop rail service will use more energy than a non-stop service on the same route. A simulation of the LRC energy consumption indicated the actual operating cycle would consume 80% more energy than the train would in a cruising mode.

The composition of vehicle types, on a route, or in a system will also influence the energy productivity. Older commercial jet aircraft are less efficient than newer ones, so the proportion of each serving a route will influence the energy intensity of all air travel on that route. For passenger train, ancillary service cars (baggage, diners, sleepers, etc.) increase the total energy consumption without contributing to the train's passenger carrying capability. Newer passenger rail equipment such as the LRC in Canada or the AM Fleet in the U.S.A. are lighter,and more fuel efficient than older equipment in comparable operations.

Environmental conditions, including wind and temperature can significantly influence the fuel efficiency of all passenger modes. Automobiles are less efficient in the cold Canadian winter than in summer, particularly for short journeys. All vehicles are influenced by the wind to some extent and for aircraft flying at high altitudes,the winds are especially important.

Vehicle idling, or the use of energy, without propulsion is not energy efficient. However idling of locomotives for extended periods of 24 hours or more is currently common practice in Canadian railways, due to the difficulties of starting a diesel engine in cold weather. GO transit has taken steps to reduce the

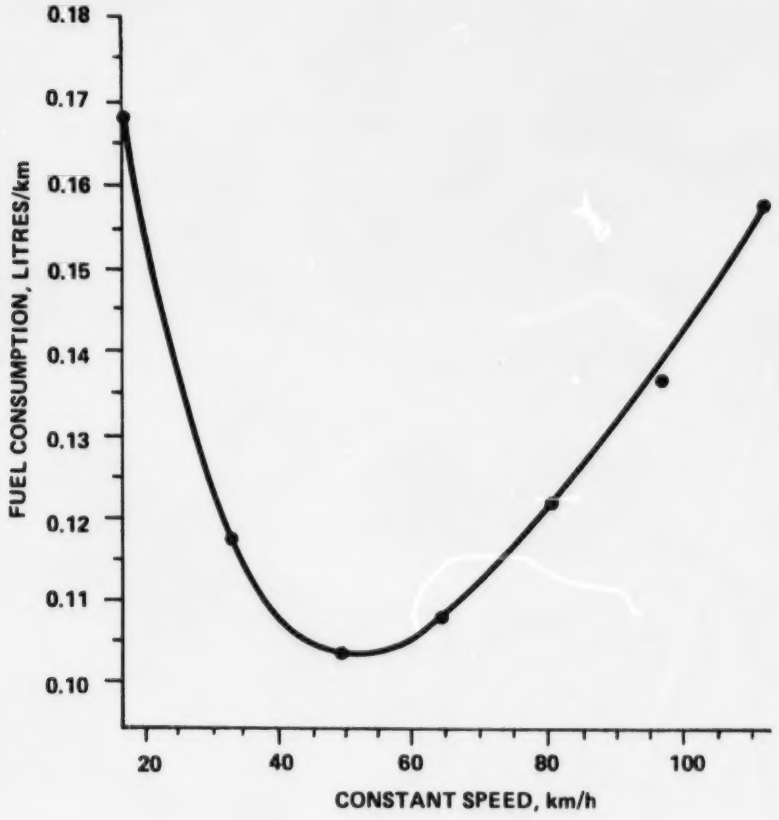
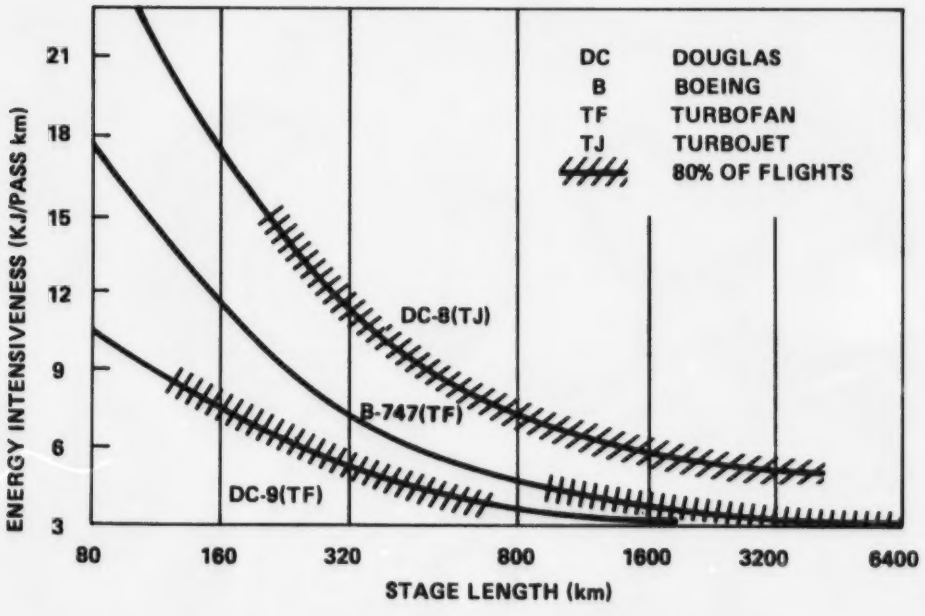


Figure 3.1/ Direct Fuel Consumption of Passenger Cars
Fuel Consumption at Constant Speed



Note: Energy Intensity Based on Load Factors of Approximately 50%

Figure 3.2/ Aircraft Energy Intensity (EI) Vs Stage Length

locomotive idling practice within its railway fleet, by installing special electric heaters. The savings have been substantial. At airports, the airlines attempt to reduce idling by shutting off unnecessary engines for taxiing and queuing where possible.

3.3 Facility Related Factors Affecting Energy Productivity

The facility related factors which affect energy productivity include the following:
- route circuity,
- grades,
- curvatures,
- surface conditions, and
- traffic control devices.

The route circuity or actual distance traveled vs. straight line distance affects the effective energy efficiency of various modes. Difficult terrain, limited routing alternatives, settlement patterns, and traffic patterns can influence the route circuity. As an example, air travel occurs within well defined corridors, designed to separate traffic both horizontally and vertically. Therefore, even aircraft do not necessarily follow the shortest air distance between two points. There can be significant variation between modes in terms of route circuity for a given city-pair.

The other factors, such as grades, curvatures, and surface conditions and their impact on the operation of the automobile, bus or railway have been studied extensively. Minimizing grades, curvatures, and traffic control devices result in greater energy productivity.

The consideration of the facility related factors would appear to be more relevant in project or operational improvement studies than in system studies.

3.4 Items for Consideration in Indirect Energy Consumption.

There are many more factors that could be considered in reviewing indirect energy consumption when compared to direct energy consumption. (See Table 3.4). This poses two problems: the data quantity and data quality required to produce satisfactory estimates.

Due to current data limitation, most studies investigating indirect energy consumption have had to resort to using very general data, often from economic input/output models, which deal with the dollar flow rather than the energy flow between various sectors of an economy. The dollar flow is then translated into energy flow. Considerable judgment is required in both developing and using indirect energy consumption estimates.

TABLE 3.4

Items for Consideration in Estimating Indirect Energy Consumption.

A. Vehicle Manufacture
- Materials and quantities
- Manufacture energy
- Useful Life
- Salvage Energy

B. Vehicle Maintenance
- Routine wear and replacement
- Road related wear
- Operation of repair facilities
- Fuel Distribution

C. Facility Construction
- Quantity-Oriented (when available)
- Excavation, backfill, dredging
- Structures
- Surface/Pavements
- Signs, Lights, HVAC
- Materials Transport
- Useful lives

Cost Oriented (when quantities are not available)
- Data /Constant dollar costs
- Location
- Type of Construction
- Useful Lives

D. Facility Operation/Maintenance
- Age
- Peripheral Equipment
- Surface/Pavement Type

E. Peripheral Effects
- Changes in land use
- Changes in fuel source
- Changes in local energy needs
- Location of energy related natural resources

4.0 Energy Productivity of the Existing Intercity Passenger Services

This chapter will examine the direct energy consumption of various transportation modes and vehicles, at both the general and specific case levels. The data used in this chapter have been obtained from various studies, using various assumptions, some of which have not been recorded. Therefore, the energy productivity or energy intensity expressed in the following material should always be treated as "estimates" and viewed in light of the qualifications discussed in the previous chapter

4.1 Automobile Energy Productivity

The energy productivity of intercity automobile travel is primarily dependent on the fuel economy of the existing automobile fleet, the load factor in each car and the surface condition of the road network. The fuel economy of the automobile fleet is expected to continue to improve at least until 1990 as new, more fuel efficient cars replace old gas-guzzlers. Figure 4.1 provides a visual picture of the dramatic improvement in fuel economy that has occurred in the United States since 1974. Canadian fuel economy figures are similar to those found south of the border.

For a given model year and trip type (urban or highway), reasonable estimates of the EI values can be made from various reports, including Transport Canada, U.S. DOE, EPA or Consumers Reports. Only Consumers Reports uses actual road tests while the other organizations rely on chassis dynamometer tests. This test method is being increasingly questioned due to the growing difference between the chassis of dynamometer results and on-the-road performance as shown in Figure 4.1.

No detailed effects on the influence of highway conditions are available for Ontario but some general estimates suggest that rough paved surfaces can increase fuel consumption up to ten percent.

Based on a review of recent studies there appears to be a wide difference of opinion as to the actual load factor for intercity automobile travel. A recent review of various roadside surveys throughout Ontario indicated the summer average occupancy to be 2.3 persons/auto. The occupancy rate varied greatly by trip purpose . The estimate of 2.3 persons/auto approximates the results from U.S. studies. Table 4.1 summarizes the available information on auto occupancies.

There is probably no "typical" value for the energy intensity of the automobile. Recent advances in automobile designs have shown that the automobile can be very fuel-efficient for highway driving, as well as comfortable even when fully loaded.

Figure 4.1

UNITED STATES AUTOMOTIVE FUEL ECONOMY STANDARDS 1967 – 1982

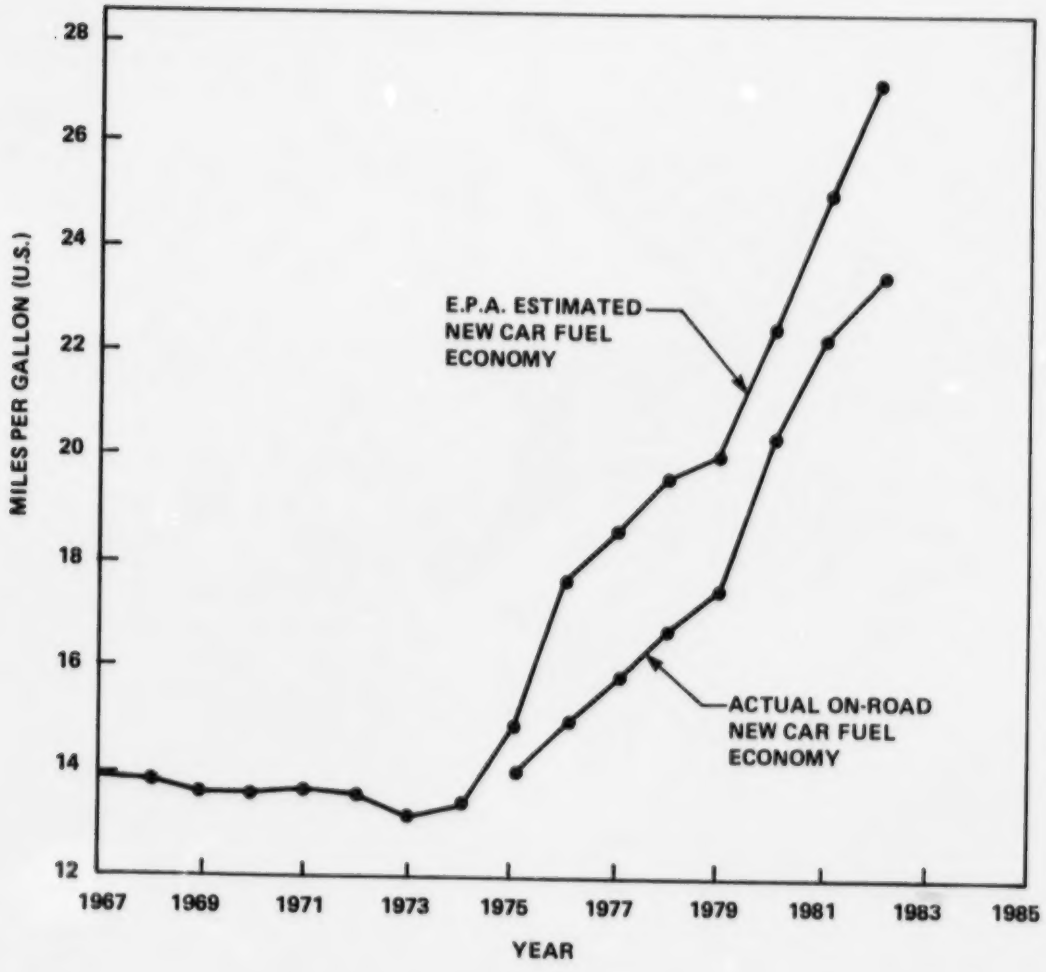


TABLE 4.1

AUTO OCCUPANCY - INTERCITY TRAVEL

A. By Trip Purpose In Ontario

Trip Purpose	Average Occupancy
Work	1.51
Social/Recreational	2.66
Other	2.23
Average	2.30

SOURCE: "Review of Travel Characteristics", L.J. Jollimore, August, 1980.

B. U.S. Auto Occupancy

Occupancy	Author
2.6	Polland
2.5	Fraise
2.1	Goss

SOURCE: Table 9,20e, "Energy Intensity of Intercity Passenger Rail", Ram Mitall, Union College for U.S. Department of Transportation, 1977.

4.2 Intercity Bus

Table 4.2 provides estimates of the Energy Intensity of intercity bus systems in the U.S.A. from 1973 through 1979. A reasonable estimate of energy would be 700 kJ/pass-km, based on 45% load factor. Under fully loaded conditions, the suggested EI value is about 300 kJ/seat-km. This makes the intercity bus the most efficient mode of intercity passenger transportation under current operating conditions.

The energy intensity of the intercity bus is affected by the operating speed, as shown below.

Table 4.2

Speed (km Per Hour)	Vehicle Efficiency (litres per 100 km)
64	40
80	45
97	59
113	87

SOURCE: N.D. Lea and Associates, Intercity Highway Passenger Transportation Technology, Efficiency and Productivity, 1975.

For typical Ontario conditions it has been difficult to obtain reliable estimates of load factors for the intercity bus. On some routes, the passengers handled exceeded the scheduled available seats, as a result of the operators using unscheduled or demand responsive extra sections in addition to their regularly scheduled services. This can result in a calculated load factor of greater than 100%.

4.3 Intercity Rail

The estimates of energy intensity for intercity passenger vary significantly from route to route and between services on the same route. The differences stem from a variety of factors, including train speed profile, gradient profile, the prime mover used (energy source) rolling stock (age, ancillary cars) and schedule characteristics. Estimates of energy intensities for selected rail services in the Windsor - Montreal corridor are given in Table 4.3.

Due to the wide variation in the estimates of energy intensity, it is not possible to provide a meaningful average energy intensity for intercity passenger rail. However, most estimates seem to be within the range of 950 to 2950 kJ/pass-km. Meaningful estimates would have to be prepared on a route or equipment specific basis.

TABLE 4.3

SUMMARY OF PASSENGER RAILWAY FUEL EFFICIENCY - 1977 (CNR)*
WINDSOR-QUEBEC TRANSPORTATION SYSTEM

Link	Distance (km)	Average Train Speed	Average No. of Stops	kJ / seat-km
Toronto-Montreal	536	109	3	988
		95	8	780
		67	10	1035
Toronto-Ottawa	443	79	7	950
		76	9	860
Ottawa-Montreal	185	84	2	655
Windsor-Toronto	357	88	5	670

SOURCE: Adapted from Ata Khan.

4.4 Intercity Passenger Aircraft

The energy intensity of passenger aircraft has shown a historical variation which closely parallels the introduction of various new aircraft into commercial service. The historical variation from 1955 to 1980 is shown in Figure 4.2. As may be expected the energy intensity varies with the engine number and type (turbofan, turbojet or turboprop). Table 4.4 shows the EI estimates for these various aircraft.

Passenger aircraft currently carry some air cargo and therefore the energy expenditure calculations should account for the impact of the freight on the passenger energy productivity. One rough rule of thumb translates 1 ton of freight into the equivalent of 10 passengers when calculating the energy intensity per passenger.

Considerable potential exists for improving the energy productivity of aircraft. Items such as the load factor, seating density, reduced speed, improved ascent and descent procedures and improved technology will contribute to reducing the EI of aircraft.

Figure 4.2

OPERATING ENERGY INTENSITY OF INTERCITY PLANES
HISTORICAL VARIATION IN EI VALUES

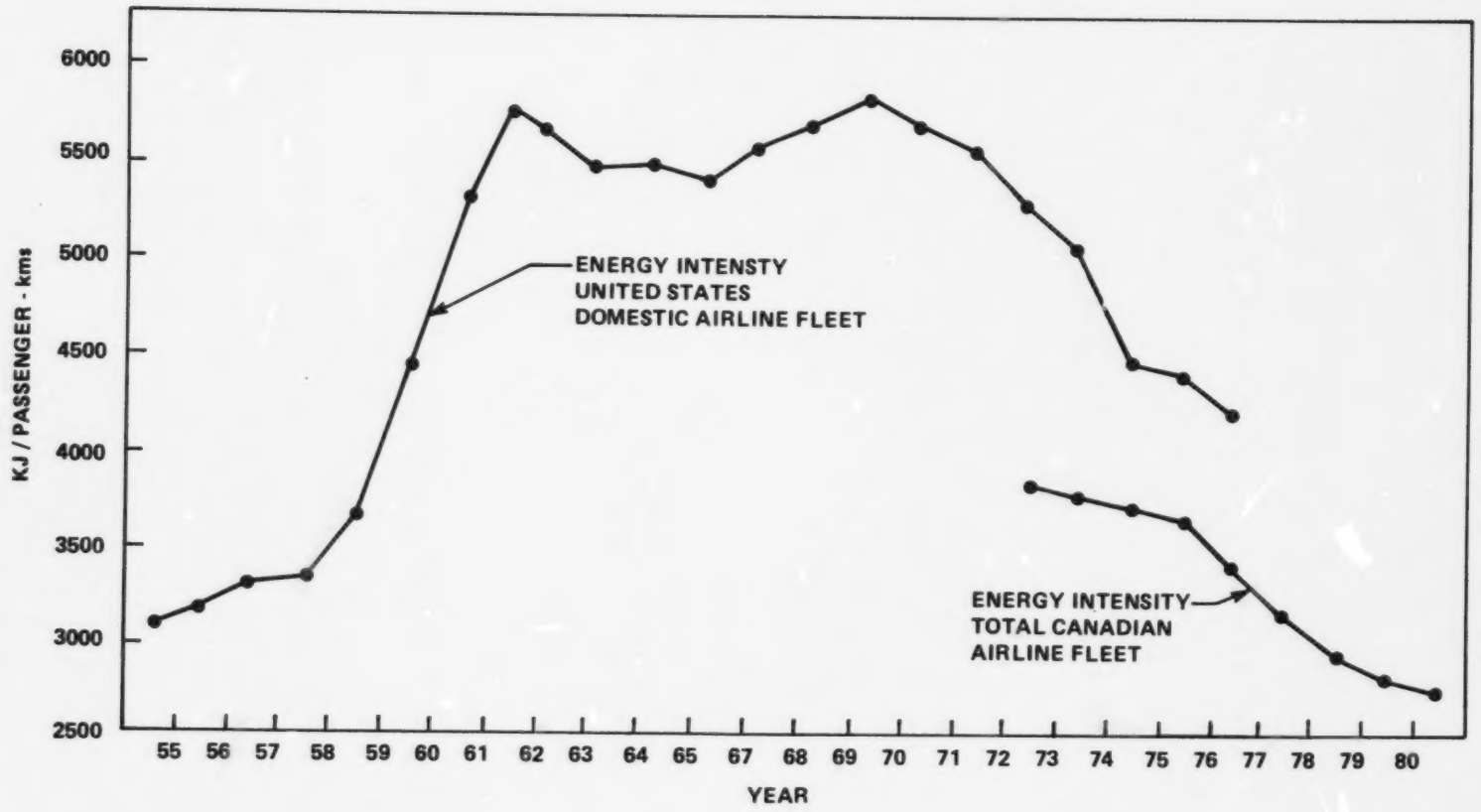


TABLE 4.4

ENERGY INTENSITY OF PASSENGER AIRCRAFT BY EQUIPMENT GROUP, 1974-1975

Equipment Group	EI - kJ/Pass-km
Turbo Fan 4 engine wide bodied (B747)	3660
Turbo Fan 3 engine wide bodied (L1011, DC10)	3750
Turbo Fan 3 engine regular body (B727)	5900
Turbo Jet 4 engine (B707, DC8)	6000
Turbo-Prop 4 engine	6720

SOURCE: State of the Art in Studies Related to Energy Efficiency of Intercity Passenger and Freight Movement, R.K. Mittal, Union College for U.S. Department of Transportation, January, 1978.

NOTES: Based on available data, including 1974-1975 Load Factors as reported to U.S. Civil Aeronautics Board.

4.5 Modal Productivity for Specific Situations

The preceding section provided a range of EI for the various modes. It was noted that the EI varied for most modes with equivalent load factor and trip length. This section will review the modes on a given route, where specific data is available, to estimate the relative efficiency of the various modes.

a) Energy Intensity for Toronto-Montreal Passenger Transportation

The Toronto-Montreal route is one of the major intercity routes in Canada. It is well served by auto, bus, rail and air, with frequency service and the most up-to-date equipment. As the route has been extensively studied in the past, a variety of data is available.

The Toronto-Montreal route is approximately 509 km in length but the actual travel distance for all modes is greater, due to routing circuity. Therefore, the transportation service provided will be referred to in terms of equivalent passenger-km. The actual and equivalent kilometres for Toronto-Montreal are shown in Table 4.5 along with information on vehicle speeds and typical observed load factors and energy intensity figures.

Table 4.5

Service Information and Energy Intensity For Toronto-Montreal Travel

Mode	Straight-line km.	Route km.	Circuity	Frequency (Daily one-way)	Av. Speed km/h	Load Factor (Average)	Energy Intensity (kJ/Passenger-km)	
							Average	Range
Bus	509	567	1.12	6	509	.55	1050	710-1300
Rail	509	538	1.06	3	100	.50	2600	1540-4350
LRC	509	538	1.06	4	110	.50	1600	1400-1800
Auto	509	573	1.13	n/a	90	.40	3800	2600-5775
Air	509	582	1.15	31	80	.58	6300	5200-8300

Based on reported information from 10 studies for Toronto-Montreal Travel.

On a terminal-to-terminal basis the modes, in terms of energy efficiency, rank as follows:

1. bus,
2. rail,
3. auto,
4. air.

There are several deficiencies to the above analysis. First the analysis has considered only the terminal-to-terminal direct energy. A complete analysis should also include the direct energy consumed for terminal access and egress. From the literature review, there appears to have been very little work directed towards quantifying this component.

Secondly there is difficulty obtaining direct fuel consumption information for intercity bus and rail modes because of engine idling and deadheading to and from storage areas. The rail mode presents further problems in that the number and type of cars vary by season and day of week in response to demand. Therefore, the time period for the estimated seating capacity should be compatible with the time period used for recording fuel consumption.

Thirdly for the automobile there are reliable measures of the vehicle occupancy, but no reliable field measures of vehicle capacity. The average vehicle capacity was estimated at five seats, based on the current fleet composition.

Lastly, a "typical energy intensity figure may not approximate the energy intensity of an individual piece of equipment".

5.0 Improvements in Energy Productivity

As previously mentioned, most modes of transportation are undergoing a series of changes in order to make both present and future equipment more energy efficient. For present equipment, the changes are in the area of operating practice such as lower speeds and equipment retrofitting. New equipment will be more energy efficient because it can start with new concepts, new designs and new engineering.

5.1 The Automobile

The fuel economy of the intercity automobile is expected to continue to improve at least until 1990, through a host of changes including lighter vehicles, improved aerodynamics, smaller engines, and advances in electronic controls. In Canada, there is additional ongoing research to improve the cold weather performance of the automobile.

5.2 Intercity Bus

The intercity bus is currently the most energy efficient passenger mode. The existing fleet of buses is powered almost exclusively by diesel engines, which contributes to this efficiency. There are very few advances anticipated in terms of energy efficiency although there is some experimentation with alternative engines and fuels (turbines, propane, etc.) and articulated buses. Early indications from the tests show cost savings may be possible but not significant energy savings. In future, if the bus operators introduce more selective luxury services, such as lower seating density, there could be a decrease in the actual energy efficiency of the intercity bus although the affect on energy productivity could go either way.

5.3 Rail Passenger Services

There are many possible improvements to the current energy efficiency of passenger rail services. The improvements can be grouped into several categories: equipment, propulsion systems, infrastructure, and operations.

In terms of equipment, the new LRC trains, introduced in the early 1980's offer potential direct energy savings through lower weight per passenger seat. Table 5.1 shows the simulated energy intensity of the LRC for optimum energy usage. The use of two engines, or the insertion of dining, snack and club coaches would lower the efficiency. It should be stressed that the LRC is intended for regional rail service and will not have sleeping accommodations.

TABLE 5.1
LRC PASSENGER RAIL DIRECT ENERGY EFFICIENCY (kJ/Seat-km)

Average Block Speed (km/h)	Consist 1-3-0 (152 seats)	1-4-0 (228 Seats)	1-5-0 (304 Seats)	1-5-0 (388 Seats)
50	833	638	536	420
60	917	699	587	460
70	997	760	638	500
80	1157	881	740	580
90	1296	988	830	650
100	1416	1079	906	710

Source: Khan, A.M., "Energy Efficiency in Canadian Intercity Passenger Transportation", Report Prepared for Strategic Studies Branch Transportation Canada (Draft March 1978).

Electrification of the rail system in Ontario has been proposed as a way of saving energy. Specifically, electrification would replace petroleum fuel with an undermined fuel (coal, oil, gas, uranium, water.) Secondly, it would use a small portion of Ontario's excess electrical power generating capability. Studies, however have concluded that rail electrification does not guarantee energy savings at the primary level although it does substitute fuels. A recent Canadian* study of the energy implications of railway electrification concluded that diesel electric and electrified rail systems would have similar primary energy intensities. In each case, the actual energy consumption would depend on the source of the electricity. Therefore, the conversion of the railways to an electrified system does not guarantee an energy savings for Ontario but it would reduce Ontario's dependence on oil. The reduction would be only in the region of 1% to 2%.

* A. Khan, Railway Electrification: Energy Implications, (Draft) Carleton University, May 1980 for Science Council of Canada.

There are many minor modifications that can be made to the existing rail infrastructure and operating practices that could result in an energy savings. Table 5.2 documents some of the opportunities and potential savings which have been identified for Canada settings.

While there are a number of ways of increasing the energy efficiency of passenger rail services, these measures may influence the level of service to the passenger. Higher seating densities, higher load factors, fewer ancillary cars, and lower speeds all conserve energy but lower the passenger service level. This could lead to less passengers per train and actually cause the energy productivity of the rail service to decrease. On the other hand high speeds, frequent service, low density seating and ancillary services lower the energy efficiency of the train but could very well lead to higher passenger utilization which would increase energy productivity.

5.4 Air Passenger Services

The airline industry is currently facing a financially difficult period as a result of the rapid increase in fuel prices and a lower rate of growth in traffic. Fuel now represents 30% of Air Canada's operating costs. The airlines have adopted a general strategy of getting increased fuel efficiency by increasing load factors and improving operations/maintenance practices where possible.

Throughout the 1980's, the major air carriers are planning to replace older aircraft (B-707, DC8, DC9) with new aircraft (B-767 and L1011) that will be 30% more fuel efficient as a result of advances in engine and airframe design. Forecasts for the year 2000, based on the implementation of high technology, show a 50% increase in airline energy efficiency over the base year of 1975.

Most airlines have increased their load factors significantly in the past several years, by offering discount fares, and optimizing schedules. Air Canada reported a system wide load factor of 68.5% for the second quarter of 1980. Given such a high load factor and the trend to increased domestic and international competition between air carriers, it will be difficult for the major air carriers to significantly increase their current load factor in the coming few years. Table 5.3 lists some of the expected changes in operating and physical make up of airline fleets expected by 1995.

In spite of the various measures, both past and future, to increase the fuel efficiency of aircraft, fuel will continue to be an increasing share of the air carriers direct operating costs (DOC). One study has forecast fuel to be between 40% and 70% of the DOC by 1987. If such forecasts do materialize, it would seem likely that air service would be significantly altered, especially on the fuel intensive short-haul routes.

TABLE 5.2

RAIL ENERGY CONSERVATION OPPORTUNITIES

Operational Opportunities	Potential Savings
Reduce Locomotive Idling	4%
Improve Train Handling	1%
Improve Consist Makeup	1%
Technological Opportunities	
Streamlining	2%
Reduce Tare Weight of Cars	1-6%
Locomotive Improvements	3-5%
Steerable Trucks	2%
Infrastructure Improvements	
Concrete Ties	1%
Gradient Modifications	?
Double Tracking	?
Total Potential	15-23%

Source: Canadian Institute for Guided Ground Transportation Canadian Railway Energy Conservation and Alternative Fuels 78-13, Queen's University.

TABLE 5.3

A. Operational Measures to Improve Aircraft Energy Efficiency

Measure	Savings (%)
Flying at optimum cruise speed	1.0-4.0
Reduced terminal delays	1.0
Reduced holding in the air	0.7
Use of cruise climb	0.4
Flying at optimum altitude	0.4
Placing aircraft load close to aft centre of gravity	0.3

B. Physical and Technological Changes to Improve Aircraft Energy Efficiency.

Measure	Potential savings (%)	Implementation possibility
Reduce operating weight by removing unused equipment	< 1	immediate
Reduce drag by improving airframe maintenance	< 1	immediate
Improve engine	1	immediate
Improve engine maintenance and components	5	1980
Fit high-bypass engines on narrow-body aircraft	15 on applicable aircraft	1980
Install prop fan engine (turboprop)	15-20	late 1980s
Install various aerodynamic improvements (winglets, supercritical wings, high aspect ratios, active controls)	10-20	middle-to-late 1980s
Laminar Flow control	20-40	1990
Use of composite primary structures	10-15	1990
New fuel-conservative engine	10 over present SOA	1990-95

Source: National Aeronautic Space Administration, NASA Aircraft Fuel Conservation Technology Program Task Force Report, Washington, D.C., 1975. (Draft)

5.5 Further Work

The study of intercity passenger transportation energy usage is relatively new. As such, it has several gaps and deficiencies in both data and procedure as mentioned in preceding chapters. Further work is required in the following areas.

METHODOLOGY: There is no universally accepted method for undertaking an energy analysis. Further work is required to document various procedures, their appropriate use, and pitfalls.

INDIRECT ENERGY: Although frequently referred to in energy studies, it is not often used due to the difficulties in data and assumptions. The number of assumptions and aggregated data have provided initial estimates of indirect energy but these estimates should be treated most cautiously. A better understanding of energy used over time in maintenance and construction is required.

DATA BASE: The data base has several weaknesses. Many studies or reports, including this one, rely on other data sources, making the data base narrow. Specific areas of weakness are:

(a) Traffic: trip length, load factor, traffic volume;
(b) Mode Characteristics: type of vehicle, number of seats and capacity of the system;
(c) Engineering Characteristics: aerodynamic characteristics, transmission and thermal;

GOODS MOVEMENT: This study has concentrated on the energy expended in the movement of intercity passengers. However, the movement of passengers and goods is highly interrelated, in terms of modes, infrastructure and energy. It would be worthwhile to compile the energy efficiency of the goods movement sector of the intercity transport system. A thorough understanding of the energy usage in both the passenger and the goods movement sectors is required if broad policies for energy conservation are to be effective.

6.0 CONCLUSION

Energy efficiency analysis is a relatively new activity and as such does not yet have an established set of procedures. The various approaches and methods to measuring energy efficiency have often resulted in conflicting and sometimes confusing estimates. The most meaningful comparisons of energy efficiency would be for specific situations and settings and with each situation being treated in a unique manner. Each analysis should use the best available data and try to avoid comparing modes operating in different time periods or in different seasons.

Notwithstanding the above comments, a bus, in general, is the most energy efficient intercity mode. Air travel is the least efficient form of travel for short trips (i.e., less than 800 km); however, it is very competitive, energy wise, on long-distance travel (i.e., greater than 1600 km). In general, rail and automobile appear to be within the same range of energy intensity, although their relative ranking would vary by load factor, route and equipment type.

Energy usage is only one of a host of factors to be considered in an overview of intercity passenger transportation. Other factors to be included in an assessment of the appropriate mode or mix of modes for a particular system or route would be user costs, travel time, frequency, user requirements, and governmental costs. Often these factors will conflict with the objective of energy efficiency. For example, while intercity bus may be energy efficient, it is not perceived as a suitable mode for business travel. Similarly the automobile, while not the most energy efficient form of travel, is very flexible, demand responsive, and perceived to have a low operating cost. These differences in terms of the objectives of intercity passenger transportation indicate the need for a full analysis of intercity passenger transportation requirements.

Bibliography of Relevant Intercity Energy Studies

1. Fairman, G., "Can the Intercity Transportation System Accommodate the Demand During An Energy Shortage?", California D.O.T. (April, 1980).

2. Hedley, T., "Energy and Air Transport", Carleton University, (May, 1975).

3. "Effects of Energy Constraints on Transportation Systems", Proceedings of the 4th National Conference, Union College, Schenectady, N.Y., U.S. Dept. of Transportation.

4. "Energy Conservation in the Intercity Passenger Transportation: The Windsor-Quebec Corridor, Vol. 1 and 2", Bureau of Management Consulting, Supply and Services, Canada, (1979).

5. Milstein, "Energy Conservation and Travel Behaviour", U.S.A. Dept. of Energy, (October, 1977).

6. Paxson, D.S., "Energy Crisis and Intermodal Competition", Association of American Railroads, presented at T.R.B., (January, 1980).

7. "Energy in Transport", Transport 2000, (April, 1974).

8. "Energy Intensity of Intercity Passenger Rail", U.S. Dept. of Transportation, (December, 1977).

9. Rose, A.B., "Energy Intensity and Related Parameters of Selected Transportation Modes: Passenger Movements", Oak Ridge National Laboratory, (January, 1979).

10. Meyer, R.F., "Energy Performance of High Speed Ground Transportation Systems", Carleton University, (February, 1976).

11. "Energy Statistics 1975-77", OECD International Energy Agency, (1979).

12. "Evaluation of Medium-Term Prospects for Reducing Transportation Sector Reliance on Petroleum - Based Fuels", Ontario Ministry of Energy (1977).

13. "Impact of Energy Futures on the Canadian Transportation Sector", Canadian Resource Conference For Transportation Development Agency, (1973).

14. "Implications of Energy Shortages to Transportation in Ontario: Progress Report No. 2 - Supply Demand Reserves", Systems Planning, Ministry of Transportation and Communications, (July, 1975).

15. "Implications of Energy Shortages to Transportation in Ontario: Part II - Impact Assessment", Systems Planning, Ministry of Transportation and Communications, (1975).

16. "Indirect Energy in Transportation", IBI for Transport Canada, Strategic Planning, (1978).

17. Khan, A., "Intercity Passenger Transport Energy Efficiency: Data Base and Case Study", Carleton University for Transport Canada, Strategic Studies Branch, (June 1979).

18. Khan, A., "Review of Energy Factors in Canadian Intercity Passenger Transportation Policy and Planning Studies", Carleton University for Transport Canada, Strategic Studies, (March, 1979).

19. "Review of Transportation Impacts of U.S. Energy Shortfalls: Preliminary Report", Lea Associates for Ontario Ministry of Transportation and Communications, (October, 1979).

20. "The Role of States in Energy", U.S. Dept. of Energy, (September, 1978).

21. "State of the Art in Studies Related to Energy Efficiency of Intercity Passenger and Freight Movement: Final Report", Union College, Schenectady, N.Y. for U.S. Dept. of Transportation, (January, 1978).

22. "Modal Energy Consumption on Selected Intercity Routes", Toronto Island Airport Study Programme, Study 3.D.4, Toronto Area Airport Project, Transport Canada, (March, 1977).

23. Lukasiewicz, J., "Transportation Energy Alternatives in North America: Assessment of Past Experience and Future Prospects", (1977).

24. "Transportation Energy Demand Analysis for Ontario", Canadian Resourcecon for Ontario Ministry of Energy, (1976).

25. "Transportation Energy Monitoring Report No. 1", Strategic Planning, Transport Canada, (November, 1978).

26. "Urban Transportation and Energy Potential Savings of Different Modes", U.S. Congressional Budget Office, (1977).

27. "Canadian Railway Energy Conservation and Alternative Fuels", Canadian Institute for Guided Ground Transportation, Queen's University, (1978).

28. Uher, "Electrified Railroad Operation in Germany and Switzerland; Review of the Status of Advanced Propulsion Systems", Carnegie-Mellon University.

29. "Electrification - Status of Research and Development", U.S. Dept. of Transportation, (1980).

30. "Energy Intensity of Intercity Passenger Rail", U.S. Dept. of Transportation, (December, 1977).

31. "Railroad Electrification in America's Future: An Assessment of Prospects and Impacts", SRI International for U.S. Dept. of Energy, (January, 1980).

32. "Changes in the Future Use and Characteristics of the Automobile Transportation System: A Technology Assessment", Office of Technology Assessment, Congress of United States, (1979).

33. Hedley, T., "Energy Conservation: Automotive Vehicles and Industry", Carleton University, (November, 1975).

34. "Lower Vehicle Operating Speeds for Energy Conservation", MTC Research and Development, (February, 1980).

35. "Intercity Passenger Transportation: Mode/Energy Conservation Vol.II Analysis", RMC Research Corp., Bethesda, MD., (December, 1975).

36. "Intercity Passenger Transportation: Mode/Energy Conservation Vol.I Executive Summary", RMC Research Corp., (December, 1975).

37. Hirst, E., "Energy Intensiveness of Passenger and Freight Transport Modes: 1950 - 1973", Report No. ORNL-NSF-EP-44, Oak Ridge National Laboratory, (April, 1973).

38. "Freight Transportation Petroleum Conservation Opportunities - Viability Evaluation", Transportation Systems Centre, Cambridge MA,(March, 1979).

39. "Competing Travel Modes", Report No. 11, Role of the Automobile Study, Strategic Planning, Transport Canada, (December, 1978).

40. "Trends in Use of Energy in Transportation", Report No. 23, Role of the Automobile Study, Transport Canada, Strategic Planning,(February, 1979).

41. "Automotive Technology Assessments and Projections to the Year 2000", Report No. 14, Role of the Automobile Study, Strategic Planning, Transport Canada, (January, 1979).

42. "Impact of Changes in Automobile Use on Other Transport Modes", Report No. 24, Role of the Automobile Study, Strategic Planning, Transport Canada, (January, 1979).

43. "Preliminary Guidelines on Cost Effectiveness and Energy Productivity of Intercity Passenger Modes", Paper No. 33, Role of the Automobile Study, Strategic Planning, Transport Canada, (January, 1979).

44. Hirst, E., "Energy Consumption for Transportation in the U.S.", Oak Ridge National Laboratory, Oak Ridge, Tennessee, (1972).

45. Hirst, E., "Transportation Energy Use and Conservation Potential", Science and Public Affairs: Bulletin of the Atomic Scientists 29(9): 36-42, (November, 1973).

46. Hirst, E., "Transportation Energy Conservation: Opportunities and Policy Issues", Transportation Journal 13 (3): 42-52, (Spring,1974).

47. Mallioris, A.C. and Strombotne, R.L., "Demand for Energy by the Transportation Sector and Opportunities for Energy Conservation", In Energy: Demand Conservation and Institutional Problems, Michael Macrakis (ed.), M.I.T. Press, Cambridge, Massachusetts, (1974).

48. Oak Ridge National Laboratory, "Energy Consumption for Transportation in the U.S.", National Technical Information Service, Springfield, Virginia, (1972).

49. Mitch, J.J., "The Potential for Energy Conservation in Commercial Air Transport", Report Number R-1360-NSF, Rand Corporation, Santa Monica, California, (1973).

50. Ontario, Ministry of Energy, "Ontario Energy Review," Toronto, (1979).

51. Ontario, Ministry of Transportation and Communications, "Energy Conservation in the Ontario Trucking Industry", Synopsis of Papers of the First Workshop Meeting, (Downsview, 1975).

52. United States, Transportation Systems Centre, "Energy Conservation in Transportation", Cambridge, Massachusetts, (January, 1979).

53. Mittal, R., "Energy Intensity (EI) of Various Transportation Modes", Aerospace Corp., El Segundo, California.

54. Mittal, R., "Analysis of Intercity Ground Transportation Alternatives to Mobility and Energy Savings", Aerospace Corporation, El Segundo, California, (January, 1979).

55. ADI Limited, "Direct Energy Use by Transport in the Atlantic Provinces", Strategic Planning, Transport Canada, Montreal, (1978).

56. Highway Research Program No. 43, "Energy Effects, Efficiencies and Prospects for Various Modes of Transportation", Transportation Research Board, Washington, D.C., (1977).

57. Shonka, Loebl, Patterson, "Transportation Energy Conservation Data Book, Edition 1", Oak Ridge National Laboratory, National Technical Information Service, Springfield, Virginia, (1977).

58. Apostolos, Shoemaher, Shirley, California Department of Highways, "Energy and Transportation Systems", Transportation Research Board, National Research Council.

59. Canadian Institute for Guide Ground Transportation "Canadian Railway Energy Conservation and Alternative Fuels", Report 78-13, Queens University, Kingston, (1978).

60. Canadian Institute for Guided Ground Transportation "Canadian Railway Electrification Study", Queens University, Kingston, (1976

Appendix A
GLOSSARY OF TERMS

This glossary is very limited in scope and is intended to explain terms used in the report. For more complete coverage see the publication, "Glossary of Energy, Economic, Environmental, Electric Utility Terminology", published by the California Energy Commission.

Average Occupancy: The average number of passengers per vehicle in some prescribed time period or operation. In aggregate operation, average occupancy equals passenger miles travelled divided by vehicle miles travelled (PMT/VMT).

Bbl: Barrels of oil (42 U.S. gallons or 35 Imperial gallons).

Barrels Per Day Oil Equivalent: A measurement applied to energy sources other than oil for the purpose of making more direct comparisons.

Btu (British thermal unit): The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at or near 39.2F, at standard pressure.

Aviation Gasoline: All special grades of gasoline for use in aviation reciprocating engines, as given in ASTM Specification D910.

Btu/Seat-mile or passenger mile: A measure of energy efficiency, generally implying the fossil fuels (or their equivalent) used in propelling the vehicle. One variation is gallons/square foot (of passenger area), advocated by some for transit operations. Btu/seat-mile is a measure of potential efficiency, resulting from 100% occupancy, while Btu/passenger-mile is a measure of actual efficiency or productivity.

Calorie: Originally, the amount of heat energy required to raise the temperature of 1 gram of water 1C. Because this quantity varies with the temperature of the water, the calorie has been redefined in terms of other energy units. One calorie is equal to 4.2 Joules. (The food calorie is equivalent to 1000 calories defined in this manner.)

Circuity: Ratio of distance actually travelled between two points, to the great circle distance between those points.

Construction Energy: Energy used to build the system, e.g., in Transit Analysis- vehicles, stations, roadbeds, terminals and associate facilities. Includes energy of the materials as well as the energy in placing them.

Distillate Oil: Fuel which may be used in diesel engines, i.e., water vessels, railroads, trucks, etc.

Energy: The capability of doing work. There are several forms of energy, including kinetic, potential, thermal, nuclear, rotational, and electro-magnetic. One form of energy may be changed to another, such as burning coal to produce steam to drive a turbine which produces electricity.

Entropy: A measure of the disorder (or chaos) in a closed system. The measure of unavailable energy in a closed system.

Ethanol: An alcohol produced via photosynthesis from plant material.

Great Circle Distance: An arc between two points on the Earth's surface formed by the intersection of a plane passing through the centre of the earth. For aircraft, it is the shortest distance between two points.

Input/Output Analysis: A matrix form of analysis, developed for the field of economics, which is a tabular summary of the goods and services used in the process of making other goods or services. The analysis is in terms of dollars and encompasses the entire nation.

Joule: The Joule is the work done when the point of application of a force of one Newton is displaced a distance of one metre in the direction of the force. (Equal to one watt/second.)

Kerosene: A flammable hydrocarbon oil that is less volatile than gasoline. It is used as a fuel or fuel component for jet engines.

KWHT: Kilowatt hour thermal - equals 3413 Btu.

KWHE: Kilowatt hour electric equals roughly 10 000 Btu, depending on the conversion loss factor assumed (.33 is typical) for converting fossil fuel into electricity.

Line Haul: Normally the distance between communities, or population centres.

Load Factor: The average ratio of passengers to seats in some prescribed time period of operation, expressed as a decimal or a percentage, e.g.,in public transit, the ratio is the average of in-bound (peak) and outbound (off-peak) operations.

Maintenance Energy: Includes energy needed to repair and maintain vehicles and other constructed items of the system.

Miles-Travelled: Are the number of miles actually covered by a service between two points.

Newton: The Newton is that force which when applied to a body having a mass of 1 kg, gives it an acceleration of one metre per second squared.

Parasitic Loads: Power requirements in a vehicle such as air compressors, cooling systems, generators and similar equipment which detract from horsepower delivered to drive wheels.

Passenger/Miles Travelled: Vehicle/miles travelled multiplied by the (average) number of passengers on board. Abbreviated PMT.

Power: The rate of flow of useful energy.

Seat/Miles Traveled: Vehicles/miles multiplied by the number of seats in the vehicle (SMT).

Station Energy: A portion of operating energy. Specifically, the associated parking lots, administration buildings including lighting and heating.

Therm: 100 000 Btu. Also that quantity of a gaseous fuel which contains 100 000 Btu in calorific heat value.

Traction Energy: Includes the energy for vehicle propulsion and any parasitic loads such as lighting, heating, air conditioning or various other energy demands within the vehicle. This term is generally synonymous with Direct Energy, a term favoured by some authors. Some disagreement has existed over what parasitic loads are to be included.

Travel Speed: Average distance/unit of time over a prescribed route.

Vehicle Miles: The sum of the distances (in miles) each vehicle travels while conducting its transport function. Abbreviated VMT.

Watt: The watt is the power which requires a supply of energy at the rate of one Joule per second.

Appendix B

ENERGY CONVERSION FACTORS

Energy Conversions

1 Btu = 1055 Joules
1 Calorie = 4.187 Joules
1 Btu = 252 Calories
1 Btu = 2.931×10^{-4} KWH

Conversion Factors

1 Imperial Gallon	= 277.420 Cubic Inches
1 U.S. Gallon	= 231 Cubic Inches
1 Imperial Gallon	= 1.2 U.S. Gallons
1 U.S. Gallon	= 0.833 Imperial Gallons
1 U.S. Gallon	= 3.785 Litres
1 Imperial Gallon	= 4.546 Litres
1 Barrel	= 35 Imperial Gallons
1 Barrel	= 42 U.S. Gallons

SOURCE: Petroleum Economist

Appendix C

ENERGY USE AND PRODUCTION-RELATED CONVERSIONS

HEAT VALUES OF FUELS

Coal		
Anthracite	25.4×10^6 Btu/short ton	= 29.7 mJ/kg
Bituminous	26.2×10^6 Btu/short ton	= 30.6 mJ/kg
Lignite	12.4×10^6 Btu/short ton	= 14.5 mJ/kg
Bituminous and Lignite		
Production	23.5×10^6 Btu/short ton	= 27.5 mJ/kg
Consumption	22.8×10^6 Btu/short ton	= 26.7 mJ/kg
Natural Gas		
Wet	1 095 Btu/ft^3	= 40.79 mJ/kg
Dry	1 021 Btu/ft^3	= 38.04 mJ/kg
Liquid	95 800 Btu/gal*	= 3569 mJ/kg
Crude Petroleum	165 700 Btu/gal	= 5145 mJ/kg
Fuel Oils		
Residual	179 640 Btu/gal	= 41.73 mJ/L
Distillate	166 400 Btu/gal	= 38.66 mJ/L
Automotive Gasoline	150 000 Btu/gal	= 34.84 mJ/L
AVGAS	148 000 Btu/gal	= 34.56 mJ/L
Jet Fuel (naptha)	153 000 Btu/gal	= 35.54 mJ/L
Jet Fuel (kerosene)	162 000 Btu/gal	= 37.63 mJ/L
Lubricants	173 300 Btu/gal	= 40.25 mJ/L
Waxes	158 200 Btu/gal	= 36.74 mJ/L
Asphalt and road oil	189 600 Btu/gal	= 44.04 mJ/L
Petroleum Coke	171 600 Btu/gal	= 39.97 mJ/L
Electricity	3 412 Btu/gal	= 0.8 mJ/L

* SOURCE: Energy and Related Parameters of Selected Transportation Modes: Passenger Movements
A.B. Rose, Oak Ridge National Laboratory, January, 1979

Appendix D

METRIC NOMENCLATURE AND POWERS OF TEN

	Value	Prefix	Symbol
One million million millionth	10^{-18}	atto	a
One thousand million millionth	10^{-15}	femto	f
One million millionth	10^{-12}	pico	p
One thousand millionth	10^{-9}	nano	n
One millionth	10^{-6}	micro	u
One thousandth	10^{-3}	milli	m
One hundredth	10^{-2}	centi	c
One tenth	10^{-1}	deci	d
UNITY			
Ten	10^{1}	deca	da
One hundred	10^{2}	hecto	h
One thousand	10^{3}	kilo	k
One million	10^{6}	mega	M
One billion*	10^{9}	giga	G
One trillion*	10^{12}	tera	T
One quadrillion*	10^{15}	peta	P
One quintillion*	10^{18}	exa	E

* Care should be exercised in the use of this nomenclature, especially in foreign correspondence, as it is either unknown or carries a different value in other countries. A "billion", for example signifies a value of 10^{12} in most other countries.